DOCUMENT RESUME

ED 263 545 CS 008 228

TITLE Developing and Improving Student Thinking Abilities. Information Packet.
INSTITUTION Maryland State Dept. of Education, Baltimore. Div. of Instruction.
PUB DATE 85
NOTE 74p.; Printed on colored paper.
PUB TYPE Guides - Non-Classroom Use (055) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Cognitive Ability; *Cognitive Development; *Critical Thinking; Elementary Secondary Education; *Evaluation Criteria; Measurement Techniques; *Metacognition; Problem Solving; Program Development; Program Evaluation; Resource Materials; Student Behavior; *Teaching Methods

ABSTRACT

The 13 articles in this information packet are intended to assist individuals involved in developing plans to improve student thinking within a school or a school district. The topics discussed include (1) the need to improve student thinking, (2) obstacles that stand in the way of teaching thinking skills, (3) practical approaches to improving thinking skills, (4) teaching for intelligent behavior, (5) teaching thinking skills through an inclusion process, (6) mediating metacognition, (7) knowing when students are getting better at thinking, and (8) some thoughts on thinking and its development. Also included are conditions determining a classroom's thoughtfulness; a list of reference materials on thinking and resources on critical thinking; questions to consider when examining thinking skills programs; and a list of thinking assessment instruments. (HOD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

DEVELOPING and IMPROVING STUDENT THINKING ABILITIES

Information Packet

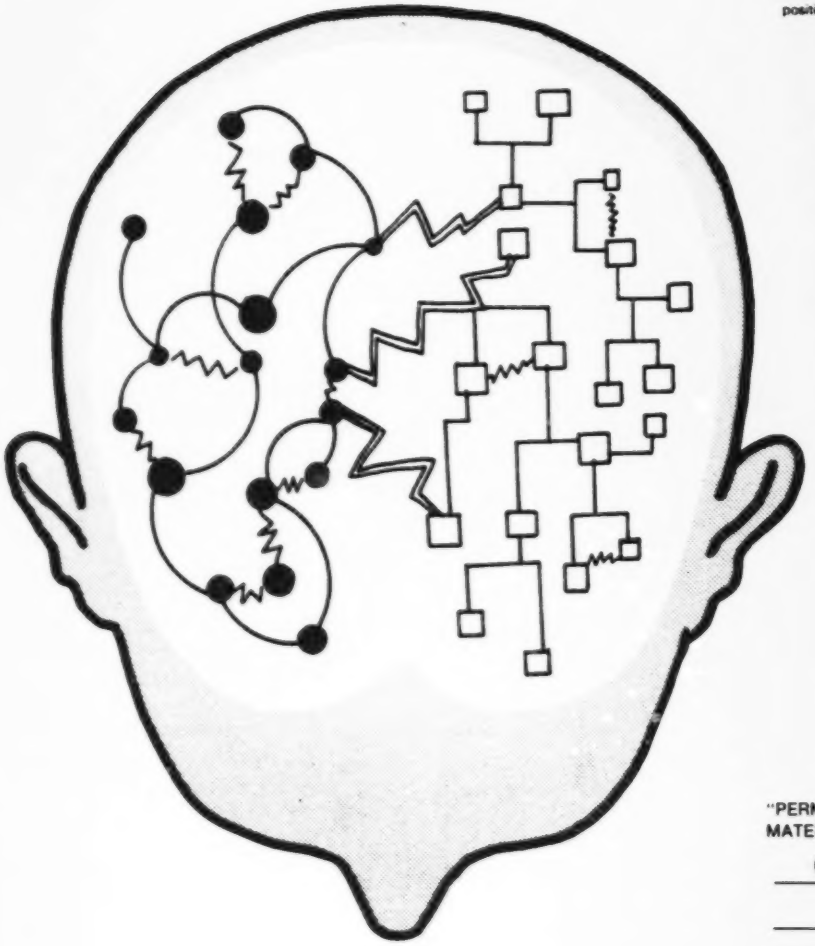
ED263545

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.



"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

G. A. Crenson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

THE MARYLAND STATE DEPARTMENT OF EDUCATION

DIVISION OF INSTRUCTION

LANGUAGE AND LEARNING IMPROVEMENT BRANCH

CS 008 228

Maryland State Department of Education
200 West Baltimore Street
Baltimore, Maryland 21201

STATE BOARD OF EDUCATION

Frederick K. Schoenbrodt *President*	Ellicott City	1985
G. George Asaki *Vice President*	Pasadena	1987
May B. Bolt	Frostburg	1989
Mary Elizabeth Ellis	Salisbury	1988
Herbert L. Fishpaw	Towson	1987
Joanne T. Goldsmith	District Heights	1985
Rosetta G. Kerr	Baltimore	1986
Albertine T. Lancaster	California	1986
Lawrence A. Shulman	Rockville	1989

David W. Hornbeck
Secretary-Treasurer of the Board
State Superintendnet of Schools

Joseph L. Shilling
Deputy State Superintendent of Schools

Richard J. Deasy
Assistant State Superintendent
Division of Instruction

James W. Latham, Jr.
Director
Division of Instruction

Glen W. Cutlip
Branch Chief
Language and Learning Improvement Branch

Jay McTighe
Specialist
Gifted and Talented Education and
Thinking Improvement Program

The Maryland State Department of Education does not discriminate on the basis of race, color, sex, age, national origin, religion, or handicapping condition in matters affecting employment or in providing access to programs. For inquiries related to Departmental policy, contact the Office of Equal Opportunity.

The following information packet is designed to assist individuals involved in developing plans to improve student thinking within a school or a school district. I hope you find it helpful.

Jay McTighe

CONTENTS

1. The Need To Improve Student Thinking: A Rationale Statement . . . . . Jay McTighe, Jan Schollenberger

2. Improving Thinking Skills- Defining the Problem . . . . . Barry Beyer

3. Improving Thinking Skills- Practical Approaches . . . . . Barry Beyer

4. Teaching for Intelligent Behavior . . . . . Arthur Costa

5. Teaching Thinking Skills- An Inclusion Process . . . . . Antoinette Worsham

6. Mediating the Meta-Cognitive . . . . . Arthur Costa

7. Checklist: How Thoughtful Are Your Classrooms? . . . . . Arthur Costa

8. Reference Materials for Thinking . . . . . Barbara Presseisen

9. Critical Thinking Resources . . . . . Mike Houck

10. Questions To Consider When Examining Thinking Skills Programs . . . . . Jay McTighe

11. Instruments for Assessing Thinking . . . . . Jay McTighe

12. Thinking: How Do We Know Students Are Getting Better At It? . . . . . Arthur Costa

13. Some Thoughts on Thinking and Its Development . . . . . Jay McTighe

THE NEED TO IMPROVE STUDENT THINKING: A RATIONALE STATEMENT

Jay McTighe
Jan Schollenberger

Helping students to become more effective thinkers is a fundamental purpose of American schooling. This goal is certainly not new. John Dewey saw the development of an individual capable of "reflective thinking" as a prominent educational objective. In 1937 the National Education Association's Educational Policies Commission included the following statement among it list of ten "imperatives", "all youth need to grow in their ability to think rationally, to express their thoughts clearly, and to read and listen with understanding."

Beyond the general interest in thinking, however, lie significant factors which point to a need for focused attention at this time. The first factor pointing to the need for thinking improvement emerges from various assessments of student thinking capabilities. Results from numerous sources consistently indicate that "the percentage of students achieving higher order (thinking) skills is declining." Some examples:

The National Assessment of Educational Progress reports,

> The most significant finding from this assessment is that while students learn to read a wide range of materials, they develop very few skills for examining the nature of the ideas that they take away from their reading. Students seemed satisfied with their initial interpretations of what they had read and seemed satisfied with their initial requests to explain or defend their points of view. Few students could provide more than superficial responses to such tasks, and even the better responses showed little evidence of well-developed problem-solving strategies or critical-thinking skills.

The recent National Commission on Excellence in Education, in its report A Nation At Risk, expresses concern that,

> Many 17 year-olds do not possess the higher order intellectual skills we should expect of them. Nearly 40 percent cannot draw inferences from written material; only one-fifth can write a persuasive essay; and only one-third can solve a mathematics problem requiring several steps.

Much attention has been given to the decline in Scholastic Aptitude Test (SAT) scores of recent years. Contrary to public opinion, this decline does not indicate a drop in basic knowledge. According to Jencks, a breakdown of the S.A.T examination questions showed no significant decline in spelling, punctuation, reading recall and the basic mathematic skills. Students were less successful, however, with those questions requiring more complex thinking such as analogy making and concept organizing.

Results such as these are no surprise to teachers of all levels who express concern that students are not able to argue effectively, to carefully examine complex problems, or to write convincingly. These feelings are shared by parents, employers, and others who recognize the importance of thinking in today's world.

A second factor supporting the need to improving thinking relates to the teaching methods currently being used in our nation's classrooms. While many teachers value thinking and employ methods which encourage its development, a number of probing studies indicate that these teachers do not constitute the norm. For example, in 1978, the National Institute of Education commissioned the Center for the Study of Reading at the University of Illinois to investigate the development of reading comprehension at the elementary level. Visiting teams observed thirty-nine classrooms in fourteen school disticts over a three-day period. Reading and social studies instruction was viewed for a total of 17,977 minutes. The general concensus was that the teaching of comprehension was practically extinct. There was no trace of comprehension being taught in any social studies session. Only 17 instances involving 45 out of 11,587 minutes were devoted to teaching reading comprehension skills.

In his recent book, A Place Called School, John Goodlad reports on an exhaustive study involving observtions of more than 1,000 clàssrooms in a variety of communities throughout the country. A summary of results showed that an average of seventy-five percent of class time was spent on instruction. Approxiamtely seventy percent of this time involved verbal interaction with teachers "out talking" students by a ratio of three to one. Observers noted that only one percent of this "teacher talk" invited students to engage in anything more than recall of information. Goodlad comments on the extreme passivity of the students that were observed and laments the lack of thinking evidenced in these classrooms.

A number of other studies have reach similiar conclusions: the majority of teachers do not regularly employ methods that encourage and develop thinking in their students.

A third factor to be considered relates to characteristics of present and future society. Much has been written about America's transition from the industrial era into an "information age." This movement has been prompted in part by the extraordinary rate of emerging knowledge in today's world. It is estimated that the information half-life (the time period during which half of the information in a field becomes outdated) of certain fields is as short as six years. We presently find fifty-five percent of the nation's work force engaged in processing and communicating information. Continuation of this trend is forecasted.

The requirements of such an age impact clearly on educational goals and practices. The National Science Board Commission on Pre-College Education in Mathematics, science, and Technology declares in its report, Educating Americans for the 21st Century.

> We must return to basics, but the basics of the 21st century are not only reading, writing and arithmetic. They include communication and higher problem-solving skills, and scientific and technological literacy-the thinking tools that allow us to understand the technological world around us." "Development of students' capacities for problem-solving and critical thinking in all areas of learning" is presented as a fundamental goal.[12]

The Association for Supervision and Curriculum Development also acknowledges the need for an expanded version of the "basics" in its 1984 statement of resolutions.

> A limited interpretation of the basics in education threatens balanced school programs for educating students living in our complex society. ASCD recognizes that further development and emphases are needed in teaching skills of problem solving, reasoning, conceptualization, and analysis, which are among the neglected basics needed in tomorrow's society.[13]

Additional support for this view resulted from the work of a committee of leaders from a variety of organizations and industries. In 1982 the Education Commission of the States directed this committee to identify those skills which would be considered "basic" for the future. They responded with the following - "Evaluation and analysis skills, critical thinking, problem-solving strategies, organization and reference skills, synthesis, application, creativity, decision-making given incomplete information, and communication skills through a variety of modes."[14]

The rapid increase in available knowledge has particular significance for education. Content teachers frequently lament their inability to cover all of the material within the content curricula. The rapid increase of the knowledge base of many subjects quantitatively compounds this task. It is clear that a different strategy is in order, one which places emphasis on developing the life-long learning and thinking skills necessary for acquiring and processing information within an ever-expanding field of knowledge.

The goal of developing school graduates with the ability to think critically is significant, yet it should not constitute the sole justification for improvement efforts. Since thinking is essential to all school subjectcs, its development should be considered a means, as well as an end.

Finally, the the fundamental requirements of our democratic society provide a powerful rationale for focusing on thinking. Democracy, as envisioned by our nation's founders, rests upon an informed and intellectually able citizenery. Edward Glaser observes,

> For good citizenship in a representative democracy is not just a matter of keeping within the law and being a good and a kind neighbor. In addition good citizenship calls for the attainment of a working understanding of our social, political, and economic arrangements, and for the ability to think critically about issues concerning which there may be an honest difference of opinion.[15]

Effective thinking is particularly important for contemporary democracy as local, national and international issues become increasingly complex. Edwin Fenton pinpoints the challenge for educators,

> Traditional civic education taught students facts and genralizations about American society and its history and attempted to instill in them a love of country and its institutions. The (new) social studies projects shifted the focus toward the intellectual processes required to solve cvic problems. But the projects failed to provide the antecedent conditions which would enable students to use these sophisticated intellectual processes. Civic educators must now find ways to facilitate development of formal operational thought, societal perspective, and higher-stage moral thought if they expect to educate students who can use the inquiry processes stressed during the 1960s.[16]

Additional sources attesting to the need and making recommendations could be cited. The message is clear, however. Educators need to take renewed action to bring about qualitative improvements in student thinking.

Reference Notes

1. Dewey, John. How We Think. Henry Regenery Company, Chicago, 1933.

2. From a report of the Educational Policies Commission. National Education Association. Washington, D.C. 1937.

3. Education Commission of the States. Denver, Colorado, 1982.

4. Reading, Thinking and Writing: Results from The 1979-80 National Assessment of Reading and Literature. National Assessment of Education Progress, Denver, Colorado, 1981.

5. A Nation at Risk: The Imperative for Educational Reform. A report of The National Commission on Excellence in Education, Washington, D.C., 1983.

6. Jencks, C. "The Wrong Answer for School Is". Washington Post. February, 1978, p.42.

7. From a study sponsored by the National Institute of Education, The Center for the Study of Reading, University of Illinois, 1978.

8. Goodlad, John. "A Study of Schooling: Some Findings and Hypotheses." Phi Delta Kappan. March 1983, pp.465-470.

9. The Future World of Work. A report from the Long Range Planning Sub-committee on Environmental Scanning/Strategic Planning Development, United Way of America, 1981.

10. For an excellent overview of demographic and social trends affecting society, see: A Profound Transformation. A slide/tape presentation produced for the American Association of School Administrators, Arlington, Virginia, 1980.

11. See also: Naisbitt, John. Megatrends. Warner Books, New York, 1984.

12. Educating Americans for the 21st Century. The National Science Board Commission on Pre-College Education in Mathematics, Science, and Technology, Washington, D.C., 1983.

13. A.S.C.D. 1984 Resolutions. A.S.C.D. Update. Vol. 26, No. 4, Alexandria, Va., May 1984.

14. Education Commission of the States. Denver, Colorado, 1982.

15. Glaser, Edward. An Experiment in the Development of Critical Thinking. Teachers College, Columbia, University, New York, 1941, p.5

16. Fenton, Edwin "The Implications of Lawrence Kohlberg's Research for Civic Education." From a report by the National Task Force on Citizen Education, McGraw-Hill, New York, 1977, p.115.

reprinted with author's permission

Improving Thinking Skills — Defining the Problem

by Barry K. Beyer

To do a better job of helping students learn thinking skills, we must confront the major obstacles that stand in the way of effective teaching of this vital subject. In this first article of a two-part series, Mr. Beyer outlines some of the more significant obstacles.

THE TEACHING OF thinking skills is a lot like the weather. Almost everybody talks about it, but few educators seem able to do much to improve it. But this failure has not been for want of trying.

Ever since the turn of the century, U.S. schools have considered mastery of thinking skills a major goal of instruction in almost all subject areas.[1] Considerable evidence suggests that we still have a long way to go in achieving this goal.[2] Why haven't we been as successful as we would like? What can we do to improve the teaching and learning of thinking in our schools?

Clearly, we can do a better job than we now do of helping students learn thinking skills. But we will *not* accomplish this goal simply by spending more time delivering the same kind of instruction as we now provide. Instead, we must constructively confront the major obstacles that stand in the way of effective teaching of thinking skills. I with to point out here some of the more significant of these obstacles, and, in an article to appear in the April *Kappan*, I will suggest some ways to deal with them.

Defining the Problem

Observers have attributed poor student achievement in thinking skills to just about everything from atomic fallout to video games and television.[3] However, I believe that the primary explanation for poor achievement is that most teachers do not teach these skills.[4] Even among teachers who do, the problem is more complex than simply too little time on task. It has to do with *how* we use our teaching time and with *what* we choose to teach.

There are at least five major reasons why we educators have not put to better use the time that we devote to teaching thinking skills. First, we do not agree among ourselves which thinking skills we should teach. Second, too many educators and developers of instructional materials do not understand — or have not defined precisely — the skills that they have elected to teach. Third, despite their best intentions, most teachers never actually provide the kinds of instruction that research suggests are most productive in developing competent thinkers. Fourth, school curricula too frequently suffer from "skills overload"; they bombard students with one-shot exposures to literally dozens of skills at each grade level, apparently on the assumption that children can master these skills on first introduction. Finally, the achievement tests currently in use in many schools may actually inhibit the teaching and learning of thinking skills; at the very least, they hinder the consistent evaluation of students' competence in these skills. Until we understand the influence of these five factors, efforts to improve the teaching and learning of thinking skills are not likely to succeed.

Lack of Consensus

Most educators agree that thinking skills (unlike social or psychomotor skills) are essentially mental techniques or abilities that enable human beings to formulate thoughts, to reason about, or to judge. The frequently used synonyms for thinking suggest the wide range of skills that thinking includes. We use the word *think* to mean, among other things, to form in the mind, ponder, decide, recall, invent, weigh, imagine, believe, and anticipate. Teaching thinking skills consists of teaching students how to engage in these behaviors.

Unfortunately, agreement seems to end at this point. Little has happened in the last 15 years to remedy what Hilda Taba once referred to as "the haziness about what is meant by thinking."[5] In what they choose to discuss or to teach as thinking skills, educators today continue to exhibit both haziness and great diversity.

Some teachers teach skills they describe as reasoning or logical analysis, which include syllogistic reasoning, spotting contradictions, deductive logic, sequential synthesis, and making inferences.[6] Others focus on the hierarchy of cognitive skills that Benjamin Bloom and his colleagues have described.[7] Some school systems teach inquiry; others emphasize problem solving, decision making, or conceptualizing. Some schools teach taxonomies of skills; others focus on discrete skills almost at random: mnemonics as well as creative thinking, Socratic reasoning as well as critical thinking. Some school systems even seek to teach their own sets of thinking skills. One such system labels these skills as clarifying issues, giving one's opinion, explaining, predicating, generalizing, and concluding.[8] Commercial publishers also offer instructional materials focused on a wide variety of thinking skills. One publisher, for example, has chosen to focus on "qualification, structure analysis, operation analysis, and seeing analogies."

This diversity might not be quite so serious a problem were it not for two related factors. First, we frequently tend to consider all thinking skills as similar in terms of complexity, utility, and function. Locally developed instructional programs often give such skills as classifying data equal status with such skills as decision making; one curriculum guide puts "locat-

BARRY K. BEYER (George Mason University Chapter) is a professor of education at George Mason University in Fairfax, Va.
©1984, Barry K. Beyer.

BEST COPY AVAILABLE

ing information in an index" on a par with "choosing from alternatives based on one's values." Obviously, with each of these two pairs, the cognitive operations are not equally complex, nor do these skills serve the same kinds of purposes. Yet we often devote equal teaching time to each skill, regardless of its complexity or its relationship to other thinking skills or procedures.

Second, considerable confusion exists among teachers regarding the definitions of these skills. Thus, although many school systems may claim to teach the same skill, we cannot be certain that the skill — as taught — is identical everywhere. Teachers vary considerably in the meanings that they assign to even the most common thinking skills. This confusion over definition manifests itself in three ways.

First, many definitions of thinking or of thinking skills are so vague that they fail to explain — and sometimes even mislead. Consider, for example, the definition of thinking as "the operating skill with which intelligence acts upon experience." Or witness the way this recently published explanation misleads: "Inquiry deals almost entirely with the convergent aspect of thinking." How helpful can such statements be in guiding the teaching of these skills?

Second, educators often define thinking skills inaccurately. For example, one prominent school system has developed a continuum of skills that lists "inquiry or recall" as a thinking skill, defines it as "to remember previously gained material," and further gives as its operational definitions "to differentiate between facts and opinions" and "to locate factual information on a time line to answer specific questions." To equate inquiry with recall flies in the face of 80 years of thinking and research in education and psychology. To equate the processes involved in distinguishing fact from opinion with those involved in matching events with dates is inaccurate, to say the least.

Nor are the descriptions of thinking skills that have been devised by state education departments immune from similar confusion and error. One such agency lists the following behaviors as geographic skills: "describes the routes, reasons, and results of exploration at various historical times and places"; and "describes the cultural contributions of an area studied and how they have affected the way things are done now in the area or other parts of the world."

One wonders what particular cognitive skills these behaviors are supposed to represent. Clearly, many educators would view them as examples of recall, not of higher-order thinking.

All too commonly, educators confuse skills with substantive generalizations, mistake simple recall for higher-order thinking, or focus on inappropriate behaviors as indicators of a particular skill. It is not surprising that students taught these "skills" may not do well on standardized tests of thinking skills; nor is it surprising that they may be befuddled when first exposed to programs that derive their scope and sequence from the thoughtful work of such scholars as Benjamin Bloom, J. P. Guilford, and Reuven Feuerstein.

The conflicting terminology we often use to describe the thinking skills we teach also demonstrates our confusion. Often we use the same word to denote different skills. For example, one widely used social studies textbook defines a conclusion as a generalization. However, a science textbook used at about the same grade level defines a conclusion as an explanation of similarities and differences; yet another textbook describes a conclusion simply as a summary. Moreover, we sometimes use labels with different meanings to stand for a single skill. For instance, many educators equate problem solving with decision making, and many others also equate reflective thinking with either or both of these — despite the fact that each phrase describes a particular set of subskills that are used in a unique order to accomplish a different kind of task. Meanwhile, the term *inquiry* seems to mean just about anything we stipulate it to mean.

Our inability to agree on the thinking skills that are essential for learning and our inability to arrive at commonly held definitions of the skills we do attempt to teach are both obstacles to professional dialogue, research, teaching, and testing in this area. Students taught a given thinking skill by one teacher may not be able to perform that same skill as it is presented by another teacher — even one in the same district — or as it appears on a district, state, or national test. Clearing up the ambiguities regarding which thinking skills to teach and how we define each is an important first step toward improving the thinking skills of students.

Many definitions of thinking or of thinking skills are so vague that they fail to explain — and sometimes mislead.

Lack of Knowledge

A second obstacle to effective teaching and learning of thinking skills lies in our failure to identify with precision those cognitive operations that constitute the individual skills we choose to teach. For example, in what cognitive procedures do we engage when we compare two or more things? What goes on in our minds when we distinguish fact from opinion, apply a previously learned concept to new information, or generalize from specifics? If we

"I'm afraid I've thoroughly messed up the seating chart, so you must take care to remember your new names."

knew the essential components of these thinking skills, we could devise better ways to teach these skills to students.

Unfortunately, there is a significant gap in the literature when it comes to specifying the cognitive components of many thinking skills. The work of such scholars as Hilda Taba, Louis Raths, and Benjamin Bloom could serve as a starting point for this task. However, until we can specify at least some of the cognitive steps involved in any given thinking skill, the teaching of that skill will remain largely hit or miss — a nebulous exercise with imprecise learning outcomes.

Unfortunately, many educators continue to view skills of all kinds as performances only, ignoring the fact that skills involve certain kinds of knowledge as well.[9] This knowledge includes rules that govern the use of a given skill and clues or other information that enable us to use the skill more effectively. Such knowledge *informs* our execution of a specific skill. It is as much a part of that skill as are the procedures by which we operationalize the skill.

For example, one basic thinking skill is that of establishing relationships. In social studies, science, and language arts classes, we frequently ask students to identify or explain relationships among given pieces of information, events, conditions, people, and so on. Students often find it difficult to do so, largely because they don't know either the wide range of relationships that could exist among data or the distinguishing clues to and features of such relationships. Students have a better chance to make connections if they know how things might be connected (e.g., spatially, functionally, comparatively, temporally) and if they know the clues that distinguish each kind of relationship. But we often fail to teach the knowledge that enables students to use this and other thinking skills — largely because we do not clearly understand what knowledge and which procedural components underlie the thinking skills we seek to teach.

Inappropriate Instruction

Much (if not most) of what teachers do under the guise of skills teaching is really skills testing. Instead of providing explicit instruction on how to perform a given skill, teachers generally put students into situations that require them to perform that skill to the best of their ability.[10] This strategy assumes that, by requiring students to use a skill (however well or poorly they understand what they are doing), they will automatically learn to perform that skill correctly — a fallacious assumption.[11] Instead, such "teaching" is likely to reinforce inappropriate or incorrect executions of the skill, to lead students to develop alternative methods of arriving at correct answers without using the skill, and to frustrate some students.

Probably the most widely used approach to the teaching of thinking skills involves the use of structured hierarchies of teacher-generated questions, either written or oral. Most teachers and developers of instructional materials who use this teaching approach assume that, in their struggles to answer the questions, students will be forced to use the kinds of thinking skills that the questions are believed to elicit. And, if such questions are asked often enough, these educators believe, students will learn the skills that the questions force them to practice.

The most common kinds of questions used to teach thinking skills appear on printed worksheets or at the end of textbook chapters. Although these questions may seem to require students to use specific thinking skills, they are just as likely to encourage students simply to copy or to guess. Moreover, these written exercises rarely (if ever) provide step-by-step instructions on how to use specific thinking skills. Most important, too many of the questions in these exercises do not even evoke the thinking skills their authors intended them to elicit.

A sample "thinking skills" exercise published by a state education agency exemplifies the dimensions of this problem. Given a time line marked at intervals of 500 years, students are asked, "During which time period did people begin to use such things as steel, factories, and electric power?" The authors of this question claim that it evokes the skill of identifying a century during which a given event occurred. Of course, whether this is really a *thinking* skill is highly questionable. That issue aside, the question relates only peripherally to the "skill," since the accompanying time line is not even divided into centuries, nor does the question specify which people. If the question involves any skill at all, it is recall — remembering previously learned facts or generalizations. More likely than not, to answer this question a student must know when steel, factories, and electric power were first used by people in many different societies. This question may validly measure a number of skills — but not the skill that its authors intended. Incorrect responses to this question can be interpreted in many different ways, but they can scarcely be seen as reflecting only a student's inability to match an event with a century.

Such a question is not atypical of those presented by most instructional materials that purport to "teach" thinking skills. The fact that this question came from materials developed by a state education agency only serves to underscore the extent to which such poorly conceived items have permeated all levels of education. By accepting such questions as models and copying or imitating them, teachers believe that they are teaching specific thinking skills, when in fact they almost certainly are not.

Rare, indeed, is the textbook that provides instructional guidelines to students on how to engage in thinking.

Textbooks are also guilty of mixing teaching and testing, of not defining clearly the skills they purport to teach, and of failing to relate learning activities to specific thinking skills. Frequently, the guides that accompany textbooks suggest that teachers ask questions that require only yes/no answers, at best. For example, the guide for a textbook that seeks to teach the "skill" of distinguishing between evidence and hypotheses suggests such questions as, "Is the idea that the people of the Southwest were farming 5,000 years ago evidence of a hypothesis?" The specific thinking skills that a student would have to employ to answer such a question correctly are left unstated — for teachers as well as for students. More to the point, the textbook never tells readers, either directly or by example, how to engage in the skills that are needed to answer this question and others like it.

In these instructional omissions, this textbook is no different from most textbooks. Rare, indeed, is the textbook in any subject that provides instructional guidelines to students on how to engage in thinking. Even the most useful textbooks provide little more than a definition of each skill and examples of its use, often only in the form of multiple-choice questions. Students are generally left to infer whatever they can about exactly how to execute a skill. Virtually all textbooks omit the most crucial part of teaching a skill, i.e., discussing its operational procedures. Because of this omission, textbooks create and reinforce the erroneous impression that we can best teach thinking skills by forcing students to answer questions that purport to be skill-related without giving them any direct instruction on how to answer such questions.

Teacher-generated "discussion" questions are a second device commonly employed to "teach" thinking skills. More

than one school system has developed elaborate questioning strategies through which teachers are expected to elicit from students increasingly sophisticated thinking. This technique suffers from all the faults that characterize written questions, however. There is little evidence to justify the assumption that students who correctly answer "higher-level" questions also understand the cognitive tasks implied by the questions. For every research study that suggests that certain patterns of questioning by teachers improve students' thinking, there is another study that suggests no connection between teachers' questioning patterns and students' mastery of thinking skills.[12]

Without direct instruction on how to answer questions, students commonly try to guess what the teacher wants them to say. Thinking undoubtedly occurs in response to such questioning — but not always the type of thinking that the designers intended. Nor is such thinking at a level of consciousness that allows students to capture, analyze, and learn the operations involved. Moreover, the use of hierarchies of teacher-initiated questions as the primary method of instruction in thinking skills contradicts the basic goal of such instruction, for it inhibits the development of learner autonomy that such instruction seeks to foster. Instruction that leads to systematic question-asking *by students* would be more appropriate, but such an approach is rare indeed.

Questions — whether on worksheets, in textbooks, or asked by teachers — do not, in and of themselves, teach thinking skills. At best, they provide only practice. At worst, they test. Educators and authors of instructional materials who persist in using such activities as the core of instruction in thinking skills simply delude themselves and others into believing that they are teaching thinking skills to students. In fact, they are not.

Skills Overload

A fourth obstacle to the effective teaching of thinking skills lies in what can best be described as skills overload: attempting to teach too many skills in too little time. This overload customarily manifests itself in three related ways.

The first symptom is the sheer number of skills that teachers attempt to teach. In an effort to remedy perceived deficiencies in skills, many authors of instructional materials and curriculum developers have emphasized the quantity of skills to be taught, not the quality of the teaching. It is not unusual to find science, language arts, and social studies curricula and textbooks today that claim to provide instruction in dozens of thinking skills within the span of a single school year. For example, in addition to offering instruction in 17 different thinking skills — from "conveying personal opinions" to "creating novel solutions" — one social studies textbook also claims to teach almost three dozen other geography, study, and research skills.

Second, as a consequence of seeking to "teach" a great many thinking skills in a relatively short time, most curricula and textbooks provide students with little more than one formal encounter with each skill. These encounters are often referred to in teachers' guides or in statements of objectives as "exposures." The implied hope is that such exposures will cause students to "catch" the target skills. But faith in happy accidents is no substitute for purposeful teaching. Learning a skill to any significant level of competence takes more than a single, vague encounter.

"One more test this month, and you'll probably end up with a disease named after you."

Questions do not, in and of themselves, teach thinking skills. At best, they provide only practice. At worst, they test.

Finally, skills overload manifests itself by a general absence in school systems and in textbook series of developmental, sequential, or integrated curricula for teaching thinking skills. Most courses or textbooks — especially at the secondary level — seem to have been developed independently of one another. All too often, thinking skills that are introduced at one grade level are never reinforced or practiced in subsequent grades. Moreover, thinking skills that are introduced in one content area are rarely reinforced deliberately in other content areas at the same grade level. One sequence of skills in social studies, recently proposed by a state education agency, introduces the skill of problem identification in the third grade, mentions it again in the sixth grade, and ignores it thereafter. Unfortunately, such a skills program — whether developed by a state agency, a local school district, or a textbook publisher — is not atypical. Because coherent, sequential instructional programs that focus on thinking skills are not widely available, teachers usually find it impossible to relate their teaching efforts to those of teachers in previous or subsequent grades. Instead, the thinking skills that are introduced or taught in any given classroom reflect the idiosyncrasies of the individual teacher — and students may or may not learn them.

Inappropriate Testing

As unlikely as it may seem, tests of thinking skills, as they currently exist and are used, may actually be a fifth obstacle to the effective learning of thinking skills. At the moment, these tests seem to determine the teaching that goes on in most of our schools. And the quality of these tests leaves much to be desired.

Many school systems launch their teaching programs by creating or adopting tests to measure what they believe is proficiency in the thinking skills they want students to master. Such decisions are often made without carefully evaluating the nature and appropriateness of the

Much so-called teaching of thinking skills consists of giving students practice in answering old test questions.

skills covered by the tests, without communicating to teachers precise descriptions of these skills, and without developing instructional programs to teach these skills systematically.

Tests of thinking skills suffer from at least two general flaws. First, almost all of them suffer from conceptual inadequacy. They measure discrete skills in isolation, ignoring, by and large, students' ability to engage in sequences of cognitive operations. Some 20 years ago Harold Berlak pointed out the dangers in assuming that measures of students' performance of isolated thinking skills adequately measure such basic processes as critical thinking or problem solving.[13] Yet test makers continue to offer tests that measure almost exclusively students' performance of discrete thinking skills.

Specific items – especially in locally developed tests of thinking skills – are also suspect. For example, some school systems have developed tests that use students' recall to evaluate their proficiency in inquiry. This is merely a symptom of the larger problem: inadequate definition of the components of the skills that are tested. In many instances, items on tests of thinking skills bear no relation to the skills these tests purport to evaluate.

The problems with such tests are exacerbated by the uses to which the tests are often put. Teachers often use test items designed to measure competence in particular thinking skills as prototypes for the instructional materials they prepare to help their students learn these skills. Much so-called teaching of thinking skills consists largely of giving students practice in answering old test questions, a procedure that probably focuses students' attention more on question-answering techniques than on the specific cognitive skills that are the intended outcomes of such activities.

An even more serious problem with the testing of thinking skills is that professional test developers fail to share with teachers the descriptions or models of skills that they use (if indeed they use any) in developing test items. Nor do they say which specific behaviors indicate competence in these skills. Lacking such information, teachers can only try to teach prescribed skills as best they know how. Two of the most popular tests of critical thinking measure quite different skills – and neither measures those skills that most classroom teachers try to teach as critical thinking skills.[14] Without a common awareness of and agreement on the components of skills selected for testing, teachers are bound to provide hit-or-miss instruction at best.

Finally, the whole aura surrounding tests of thinking skills seems likely to weaken instruction in these skills. Once it has developed and implemented an achievement test devoted to thinking skills, a school system may be lulled into believing that students' scores on this instrument are the only valid measures of the learning and teaching of these skills. In reality, such tests may not even measure the competencies they are intended to measure.

In fact, commercial or teacher-made tests using multiple-choice items may be the *least useful* way to measure students' thinking skills. The best measure of students' ability to think may be their behavior as they sift through data to arrive at a conclusion or as they go about solving a problem. The development of instruments or observation techniques that can measure such behavior ought to be a major priority of test makers.

Using carefully constructed and valid instruments to evaluate students' competence for both diagnostic and summative purposes is to be applauded. But it seems reasonable to expect congruence between the skills being tested, the techniques used to measure competence in these skills, and the nature of the skills being taught. Too often, such congruence is lacking in programs intended to teach and test thinking skills.

What Next?

If we are to improve the thinking skills of our students, as some national leaders and a significant proportion of the public now demand that we do, then we must clearly identify the changes that we must make in our teaching. This requires first an honest appraisal of what we now do with regard to the teaching of thinking skills. I have attempted in this article to describe the "state of the art" of teaching thinking skills and to identify and clearly define the things we do that may keep our students from learning to think. In the April *Kappan* I will focus on specific ways to overcome the five obstacles to effective teaching of thinking skills that I have identified here.

---

1. See, for example, John Dewey, *How We Think* (Boston: D.C. Heath, 1910); *The Study of History in the Schools* (New York: American Historical Association, 1899); "ED Calls for 'No-Nonsense' Approach to Education," *Higher Education Daily*, 24 November 1981, p. 5; and National Commission on Excellence in Education, *A Nation at Risk* (Washington, D.C.: U.S. Government Printing Office, 1983).

2. "Students Lack Analytical Skills, NAEP Says," *Report on Education Research*, 25 November 1981, pp. 1-2; *Reading, Thinking, and Writing: Results from the 1979-80 National Assessment of Reading and Literature* (Denver: National Assessment of Educational Progress, 1981); Susan Walton and Thomas Toch, "Competency Tests Linked to Decline in Analytic Skills," *Education Week*, 8 December 1982, pp. 1, 17; Gene Maeroff, "Teaching to Think: A New Emphasis in Schools and Colleges," *New York Times Magazine*, 9 January 1983, pp. 1, 37; and Thomas Toch, "That Noble and Most Sovereign Reason – States, School Districts Display Growing Interest in the Teaching of Thinking Skills," *Education Week*, 9 June 1982, pp. 7, 16.

3. Ernest J. Sternglass and Steven Bell, "Fallout and SAT Scores: Evidence for Cognitive Damage During Early Infancy," *Phi Delta Kappan*, April 1983, pp. 539-45; and Maeroff, "Teaching to Think. . . ."

4. See, for example, Lynne Ames, "The Need: Teachers Who Can Make Them Think," *New York Times Magazine*, 9 January 1983, pp. 40-41; and Catherine Cornbleth and Willard Korth, "If Remembering, Understanding, and Reasoning Are Important. . . ," *Social Education*, April 1981, pp. 276, 278-79.

5. Hilda Taba, "Implementing Thinking as an Objective in Social Studies," in Jean Fair and Fannie R. Shaftel, eds., *Effective Thinking in the Social Studies* (Washington, D.C.: National Council for the Social Studies, 1967), p. 26.

6. See, for example, the materials produced by the Institute for the Advancement of Philosophy for Children, Montclair State College, Upper Montclair, N.J.

7. Benjamin Bloom et al., *Taxonomy of Educational Objectives – Handbook I: Cognitive Domain* (New York: David McKay, 1956).

8. This school system will remain nameless, as will all other sources of specific examples that I cite in this article. The intent of such examples is not to embarrass; similar examples could as easily be found in the instructional materials produced by dozens of other school systems, state education agencies, or commercial publishers. I present these particular examples simply to demonstrate that my assertions are based on hard evidence, not on supposition. By providing such examples, I also hope to encourage educators to examine their own practices for similar flaws. However, I will be happy to provide the source for any example I cite, if the reason for the request is legitimate.

9. See, for example, David Pratt, *Curriculum Design and Development* (New York: Harcourt, Brace, Jovanovich, 1980), pp. 312-14; and Robert H. Ennis, "A Concept of Critical Thinking," *Harvard Educational Review*, Winter 1962, pp. 81-111.

10. Catherine Cornbleth and Willard Korth, "In Search of Academic Instruction," *Educational Researcher*, May 1980, p. 9; and Cornbleth and Korth, "If Remembering, Understanding, and Reasoning Are Important. . . ."

11. Edward de Bono, *Teaching Thinking* (London: Maurice Temple Smith, 1976), p. 104.

12. Meredith D. Gall, "The Use of Questions in Teaching," *Review of Educational Research*, December 1970, pp. 707-21; Philip H. Winne, "Experiments Relating Teachers' Use of Higher Cognitive Questions to Student Achievement," *Review of Educational Research*, Winter 1979, pp. 13-49; and Doris L. Redfield and Elaine Weldman Rousseau, "A Meta-Analysis of Experimental Research on Teacher Questioning Behavior," *Review of Educational Research*, Summer 1981, pp. 237-45.

13. Harold Berlak, "New Curricula and Measurement of Thinking," *Educational Forum*, March 1966, p. 309.

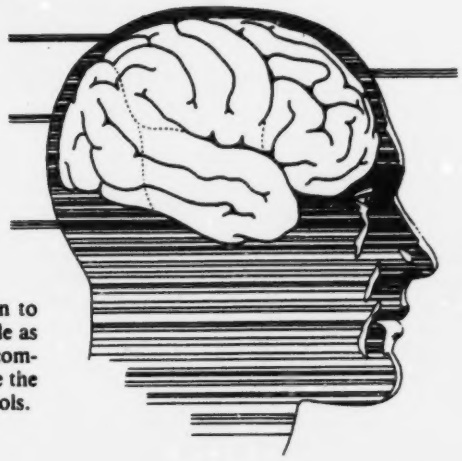
14. John E. McPeck, *Critical Thinking and Education* (New York: St. Martin's Press, 1981), pp. 132-50. □

reprinted with author's permission

Improving Thinking Skills — Practical Approaches

by Barry K. Beyer

We can improve children's learning of thinking skills, avers Mr. Beyer. He discusses five steps that educators can take to bring about this improvement.



IN A RECENT poll of professional educators, nine out of 10 respondents said that better instruction in thinking skills should be a major priority in educational planning for the coming years.[1] Government and business leaders and a sizable segment of the American public support this same initiative.[2] But the question still remains, What should — or can — educators do to bring about the improvement in thinking skills that so many people seek and expect?

In the March *Kappan* I identified five factors that explain, in my view, our current lack of success in teaching thinking skills: our own confusion over which skills to teach as thinking skills, our failure to identify the components of those skills we do elect to teach, our use of inappropriate teaching techniques, curricula that attempt to "cover" too many skills in too little time, and the lack of congruence between what we teach and what we test as thinking skills.[3] By paying deliberate attention to each of these factors, we *can* improve children's learning of thinking skills.

There are at least five steps that educators can take to bring about this improvement. First, we can identify and clearly define a core of thinking skills that we all ought to teach. Second, we can identify as precisely as possible the components of each of these skills. Third, we can provide direct, systematic classroom instruction in how to use these skills in all appropriate content areas and across all appropriate grade levels. Fourth, we can devise and implement developmental curricula that integrate the teaching of selected thinking skills — and their combined use — within various content areas. Finally, we can devise measures of competence in the use of thinking skills that are congruent with the skills we have chosen to teach and that are as valid and reliable as possible. I believe that we must accomplish these tasks, if we are to improve the learning of thinking skills in our schools.

BARRY K. BEYER (George Mason University Chapter) is a professor of education at George Mason University in Fairfax, Va.
©1984, Barry K. Beyer. *This article is the conclusion of a two-part series.*

Identifying the Skills

Before we can do a better job of teaching thinking skills, we must clearly identify the specific skills we wish to teach. This task involves distinguishing among: 1) the broader, more all-encompassing thinking processes, such as problem solving; 2) the more discrete and basic (i.e., "micro-thinking") operations — such as recall, extrapolation, and synthesis — that make up these broader thinking processes; and 3) combinations of the two, such as critical thinking.[4] This task also involves developing clear definitions of the skills we have chosen to teach and developing a common language with which to describe these skills — a language applicable across all disciplines and grade levels.

The distinction between broad thinking processes and discrete, micro-thinking operations is a crucial one. Benjamin Bloom and his colleagues have provided the best available inventory of the micro-thinking skills we should be teaching in our classrooms.[5] Their list includes six types of skills: 1) recall, 2) comprehension (translation, interpretation, extrapolation), 3) application, 4) analysis, 5) synthesis, and 6) evaluation. The Bloom taxonomy has gaps — particularly in its descriptions of the precise operations that constitute those classes of skills described as application, analysis, and synthesis. Nonetheless, this list might well serve as the common core of basic thinking operations to be taught in all classrooms.

It is important to note that the Bloom taxonomy does not include problem solving, conceptualizing, or decision making. These operations are more than discrete cognitive operations. They are complex processes that involve the specific operations listed by Bloom — but employed in different sequences to accomplish different goals. Problem solving, conceptualizing, and decision making are simply *not* of the same order as recognition or recall.

Nor are problem solving, conceptualizing, and decision making identical processes. As problem solving is commonly described, for example, the process consists of at least five major steps: 1) identifying and clarifying a problem, 2) hypothesizing solutions to the problem, 3) testing the various alternative solutions, 4) choosing the "best" solution, and 5) applying the solution.[6]

Decision making, by contrast, is often viewed as consisting of a different set of steps, such as: 1) stating the desired goal or condition; 2) stating the obstacles to realizing this goal or condition; 3) identifying the alternatives available for overcoming each obstacle; 4) examining the alternatives in terms of the resources needed to carry them out, the costs involved, and the constraints inherent in their use; 5) ranking the alternatives in terms of their probable consequences; and 6) choosing the best alternative.[7]

Conceptualizing and reflective thinking are other processes of the same order as decision making and problem solving. All of these processes differ from one another. However, the various cognitive operations that Bloom and his colleagues have described are employed in different sequences in each process to serve various purposes. Unfortunately, the specific operations that constitute these processes have not always been clearly delimited; moreover, even when they have been delimited, many educators do not know them well. Until both of these conditions are remedied, the teaching of these

processes will meet with only limited success.

We must also clarify what we mean by the term *critical thinking*. Currently, this term seems to have a variety of commonly accepted meanings in educational practice.[8] To dispel this confusion, Robert Ennis has sought to describe the set of skills involved in critical thinking.[9] We must now make a thorough and concerted effort to build on his work, in order to clarify exactly which skills constitute critical thinking. Our final list might look something like this: 1) distinguishing between verifiable facts and value claims; 2) determining the reliability of a claim or source; 3) determining the accuracy of a statement; 4) distinguishing between warranted or unwarranted claims; 5) distinguishing between relevant and irrelevant information, claims, or reasons; 6) detecting bias; 7) identifying stated and unstated assumptions; 8) identifying ambiguous or equivocal claims or arguments; 9) recognizing logical inconsistencies in a line of reasoning; and 10) determining the strength of an argument.

I have described the three different types of thinking skills in some detail simply to emphasize my claim that thinking consists of several different kinds of mental operations: broad, general processes; discrete micro-operations; and that combination of operations involving analysis and evaluation that we commonly designate as critical thinking. We should include all three kinds of thinking in any effective program designed to teach thinking skills. Moreover, we need to identify and clearly define the skills that are involved in each of these operations.

Identifying Skill Components

Our descriptions of the thinking skills we teach appear to be the single most important factor in shaping the teaching of those skills. If our definitions of the skills are imprecise, superficial, or wrong, our teaching – and, most probably, the resultant learning – is quite likely to be the same. However, the more precise and detailed our conceptualizations of the thinking skills we teach, the more likely that our teaching of these skills will be precise – and thus the more likely that our students will be able to learn such skills to the point of employing them effectively on their own in unfamiliar situations outside the classroom.

Thinking skills consist of more than "doing." They consist of different kinds of knowledge as well.[10] In fact, it seems to me that any thinking skill – whether it be a process, a discrete operation, or some mix of the two – consists of at least three components. First, a thinking skill consists of a set of procedures that one undertakes to make the skill operational. Second, it consists of knowledge of rules that guide and direct our use of these operations. And third, it consists of knowledge of the clues or indicators to look for in employing these rules. The knowledge components of any skill inform our execution of that skill, and they are as much a part of the skill as are the procedures we use in "doing" the skill.

Each of these three basic attributes of any thinking skill contains several components. The *operating procedures* of a given skill are those procedures we use for starting to use the skill, for carrying it out, and for concluding it. (For example, an initial procedure for classifying data is to select data.) A variety of *rules* guide the use of these operating procedures – including rules for when to start using the skill, rules for what procedure to use next (sequencing rules), rules for what to do when the procedures don't work well (emergency rules), and rules governing the appropriate skill(s) to employ when all the procedures associated with this particular skill have been used.

Criteria for judging the effectiveness of the particular skill we are using constitute a second kind of knowledge. These criteria, which differ for each skill, enable us to judge the adequacy and the appropriateness of using a given skill for a given purpose.

A third type of knowledge – which I will call *associated knowledge*, for want of a better term – enables us to make a particular skill operational. For example, many youngsters can't classify well, not because they don't know the procedures for classifying but because they don't know the multitude of different categories into which data can be classified. Limited by experience, imagination, or information, they often use only observed (i.e., physical) traits as categories. As students gain experience, however, they begin to infer associations or abstract traits of the data (functions, feelings, and so on), and they add these to their repertoire of categories. Still later, they develop analytical concepts that inspire other categories into which data can be classified.

For example, most youngsters looking at data about communication are likely to put the data first into categories of air, sea, or land. Later they move toward a more sophisticated categorizing system that involves senders and receivers, links or avenues of exchange (media), obstacles or interference, flow, messages or loads, and so on. This latter set of attributes is not part of any procedure of classifying; it is instead a concept of communication. Knowledge of such analytical, substantive concepts as communication supports and enhances the use of thinking skills. The information related to these analytical concepts must be taught in close relation to the teaching of the thinking skills to which they relate.

Unfortunately, few descriptions of these three components of the various thinking skills now exist.[11] Nevertheless, educators who are interested in developing students' thinking skills can do much on their own to identify the components of the various skills. One way they can do this is by devising activities that require expert users of a particular skill to engage in that skill, recording their actions as they do so. Such written records of thinking in action can be analyzed, in order to infer the rules and operations that seem to distinguish the particular skill in question.[12]

Teachers can also engage in the skill

"I personally made a small error in addition and then, using my pocket calculator, compounded it 35 times."

Clear and detailed conceptualization of thinking skills is a must for effective teaching and learning of these skills.

themselves and then reflect on what they did first, did next, and so on.[13] From such inquiry, they can identify the major components of any skill and some of the key ingredients of each component. This technique can add immensely to our understanding of the knowledge and operating procedures that constitute a skill.

If we identify the basic components of classifying, for example, we will find that, given a set of data, an individual generally: 1) skims the set to get a general impression of the kinds of data with which he or she must deal; 2) picks out one particular, prominent feature or variable; 3) notes as many pieces of data as possible that share the same distinguishing feature; 4) chunks these data together; 5) states the category label of this subset of data; and 6) repeats this process until all the data in the set have been placed into categories.

When we analyze their thinking strategies, we also find that successful classifiers follow a number of rules. When in doubt, they start a new category. They stay with one category long enough to find several examples of it – but not so long that they begin to force items into unnatural groupings. Before exhausting one category, they go on to another. Successful classifiers also know a range of possible categories into which they can chunk the data with which they are working. Such pre-existing categories serve learners both as searchlights and as storage bins.

Knowing the operational steps of classifying, as they are listed above, can make the skill of classifying much easier to learn and to teach. By explaining and demonstrating these steps to students – asking them first to state their goal or purpose for classifying a given set of data, next to skim the data, then to match two pieces of data and *immediately* label the category into which they fit, next to search for other pieces of data that fit this category, and then to repeat the process until all the data have been placed into categories – we can provide the kinds of instruction that will prove most useful in learning this skill. Clear and detailed conceptualization of the thinking skills we seek to teach is a must for effective teaching and learning of these skills.

Providing Appropriate Instruction

The learning of thinking skills requires much more than completing worksheets, answering end-of-chapter questions, writing essays, or answering "higher order," teacher-generated discussion questions. These activities may be useful, but they are not sufficient – singly or in combination – for learning a thinking skill to any degree of mastery. This is the case because such activities customarily focus on the substantive products of using a skill and only indirectly on the skill being "taught." To bring students to the point where they are willing and able to use thinking skills independently and effectively in a variety of settings, teachers will have to teach these skills much more directly than most of them now do.[14]

Research on the learning of skills seems to offer some useful insights into how we might teach thinking skills more directly.[15] This research suggests that any skill is learned best when learners: 1) are consciously aware of *what* they are doing and of *how* they do it, 2) are not distracted by other inputs competing for attention, 3) see the skill modeled, 4) engage in frequent – but intermittent (not massed) – practice of the skill, 5) use feedback received during this practice to correct their use of the skill, 6) talk about what they did as they engaged in the skill, 7) receive guidance on how to use a skill at a time when they need the skill to accomplish a content-related goal, and 8) receive guided opportunities to practice the skill in contexts other than that in which the skill was introduced.

These principles suggest that teachers should continuously make explicit for learners the mental activities employed by successful users of the skill being taught.[16] I will briefly describe two of the many such teaching strategies available for accomplishing this goal.

The first, developed by Arthur Whimbey, stems from research conducted by Benjamin Bloom and Lois Broder more than 30 years ago.[17] In general, Whimbey's strategy calls for the following learning sequence: 1) a student attempts to solve a problem while reporting aloud his or her thoughts and procedures (both of which are open to question by other members of the class); 2) all students read and discuss a step-by-step description of the method used by another individual to successfully solve the same problem; 3) a second student attempts to solve a new problem while thinking aloud, with the class observing and trying – through questioning – to help him or her emulate the procedures demonstrated by the model; and 4) all students read and discuss a step-by-step descrjption of a successful solution to the second problem. Steps 3 and 4 can be repeated several times, using different problems. Eventually, students work in pairs to solve problems, with one member of each pair thinking through a problem aloud while the other checks for accuracy and keeps the problem solver verbalizing his or her thoughts and actions. Each pair also reads transcripts of successful solutions to their problems, and they share

"I looked at the first essay question, and my whole life flashed before my eyes."

ideas on how best to apply these models to new problems. The students reverse roles as they work new problems.[18]

The second strategy for teaching thinking skills is more teacher-directed and systematic. In this strategy, 1) students first use a specific thinking skill to accomplish several subject-matter-related tasks, but they focus on the outcomes of using the skill rather than on the skill itself (a step that establishes readiness to learn the skill). Then, 2) the teacher introduces the skill in considerable detail, explaining and demonstrating its components, after which the students immediately apply the skill and then reflect on and discuss the procedures they used to carry out the skill. Next, 3) during the coming several weeks the students practice the skill three to four times. Each such lesson begins with a review of the skill components and concludes with students reviewing the steps they went through to apply the skill. When appropriate, 4) the teacher explains and demonstrates new components or new applications of the skill. The students immediately apply these new learnings and then review and discuss them. The goal here is to help students generalize the skill to other contexts. Finally, 5) students continue to practice the skill by using it to achieve subject-matter-related goals. Each application is preceded by an explicit review of the procedures and rules that govern the use of the skill; after each application, students discuss their own use of the skill – moving closer each time to autonomous use of the skill in a variety of contexts.

This teaching strategy uses the principles suggested by research on the learning of skills, which I have listed above and which I have described in greater detail elsewhere.[19] In essence, the strategy takes students from readiness to learn a skill through direct instruction on how to use it, repeated practice, and review of the skill in a variety of contexts. This strategy can be used within a single course or across courses and grade levels; it is also applicable to all thinking skills and processes.

Other strategies have also been suggested for improving the teaching of thinking skills. For example, Elliot Eisner has recommended that teachers give students repeated opportunities 1) to discuss different views on the same subject, 2) to state and defend their own views, and 3) to debate and discuss their views with one another.[20] Ted Feeley advocates teaching the importance of a skill and the types of problems associated with its use, teaching the criteria that govern the use of that skill, and providing children with opportunities to use the skill in a variety of settings.[21] Other strategies stress teacher-guided questioning and discussion.[22] However, none of these strategies relies as strongly on the basic principles of skill learning, listed above, as do the first two strategies explained above.

The key to effective, direct teaching of thinking skills is to give students repeated opportunities to apply the skill – preceding each application with explicit instruction on the use of the skill and following each application with discussion among students on how best to use the skill. The focus throughout must remain on the skill being taught or applied. Teachers must give students models of the skill in use, and students must reflect on and discuss the procedures and rules that govern use of the skill. Lessons that do not include these basic features fail to provide meaningful instruction in thinking skills.

Developing Sequential Curricula

Research suggests that skills taught in isolation from subject matter are not likely to transfer easily to other situations where they can be used productively. Research also suggests that skills taught in isolation from one another are not likely to become functional.[23] Furthermore, research suggests that massed practice of skills is not as effective in promoting learning as intermittent practice and reinforcement over a long period of time.[24] Thus the research that has been conducted seems to argue for sequential instruction in thinking skills across all subject areas and throughout all grades, K-12. Few such curricula exist, but they should be developed.

An effective curriculum on thinking skills should exhibit five important features. It should introduce a limited number of thinking skills (perhaps three to five) at each grade level, clearly describe for teachers the key components of each skill to be taught, provide for the teaching of the same skill across all appropriate content areas, provide instruction in each skill in a variety of media and contexts, and provide sequenced development of each skill from the primary through the secondary grades.

Of these features, the carefully sequenced development of thinking skills is probably the most important and the most difficult to accomplish. Instruction in each skill should move through four stages – introduction, reinforcement, extension, and practice – both within and across courses and grade levels. Instruction in a particular skill at any given grade level should build on or incorporate skills introduced in preceding grade levels and set up skills to be introduced later. Skills should not be introduced at one grade level and ignored for two or three subsequent grade levels – or even forever. Nor should complex skills be introduced in detail before the subordinate skills have been mastered.

Skills should not be introduced at one grade level and ignored for two or three subsequent grade levels.

No tested (or even generally agreed upon) K-12 sequence of specific thinking skills seems to exist. However, curriculum developers might well consider a thinking skills curriculum that introduces and reinforces in the early elementary grades simplified versions of the skills of recall, comprehension, classifying, comparing, and contrasting. While encouraging students to expand and practice these skills in the intermediate grades, teachers could introduce simplified versions of analysis and synthesis and perhaps the general process of problem solving. Middle and junior high schools might prove to be the best places to introduce additional analytical skills, judging, and simple decision making. Students at this level should also expand and practice skills that have been introduced earlier. Critical thinking skills and conceptualizing could be introduced in grades 8 through 10. At each grade level, the introduction of a new skill might be assigned to one specific content area, with follow-up practice of the skill to be undertaken later in other appropriate content areas. As students move upward through the grades, they should continue to practice previously introduced skills; teachers should also introduce new attributes of these skills and provide opportunities for students to generalize these skills beyond the content areas in which they were introduced – as well as beyond the confines of the classroom.

Sequencing the teaching of thinking skills from grades K through 12 has two important advantages. First, this approach assigns responsibility for introducing, reinforcing, and expanding specific skills in specific subject areas at specific grade levels, when the skills are appropriate to children's cognitive development, as we currently understand it, and to the demands of the subjects they are studying at these grade levels. Second, a sequenced approach guarantees that children will receive instruction in the discrete skills involved in the more complex thinking processes before these processes them-

Tests ought neither to define the thinking skills we teach nor to sidetrack us from the real tasks that face us.

selves become the focus of instruction and evaluation.

If we are to improve the learning of thinking skills in our schools, we need some research on which skills can best be introduced where. We also need interdisciplinary curricula and instructional materials that incorporate the findings of such research. Until these materials are commercially available, local education agencies will have to develop their own or borrow from the best of those that exist – if any do.

Improving Skills Testing

Finally, we can improve the teaching and learning of thinking skills by attending more carefully than we now do to the nature and role of skills testing in our schools. Although the point seems obvious, I will repeat it: there ought to be congruence between the thinking skills we teach and those we test.

Teachers and test makers should use the same skills models. It does teachers little good if test makers design instruments to measure student competence in particular skills as they – the test makers – imagine these skills to be, while teachers are teaching and students are trying to learn the skills in other forms. Teachers, developers of instructional materials, and test makers should agree on descriptions of the skills to be taught and tested. Only then will we be able to test what we teach.

Furthermore, if the test items are to have any validity at all, they must present content or data about which students have not yet formed generalizations or knowledge claims. Ideally, test items should confront students with unfamiliar data about which they have no preconceived notions and to which they must apply specific skills to arrive at correct answers. To measure students' proficiency in the skill of classifying, for example, a useful test item would provide information that the students had not studied, asking them to group this data and report the results. Or a useful test item might report how someone else had grouped the data, asking students to identify the rules for classifying that had been employed incorrectly.

Tests of thinking skills ought also to reflect, both in their construction and in the reporting of results, what we understand to be the nature of the skills they seek to measure. Many tests, for example, seek to measure collections of specific, individual skills, but they report student scores in terms of their overall performances. This seems to be particularly true of some tests of critical thinking.[25] If we had valid measures of both the discrete skills we teach and of such general processes as problem solving and decision making, better instruction – and thus better learning – would be much more likely to occur.

Testing plays an important role in our teaching of thinking skills, but tests ought neither to define the thinking skills we teach nor to sidetrack us from the real tasks at hand. If we are to improve students' learning of thinking skills, we must take a careful look at the nature of the thinking skills that existing tests claim to measure and insure that those skills are congruent with the skills we seek to teach.

As Theodore Sizer and others have argued, improving the learning of thinking skills is an appropriate concern of educators and of the American public today.[26] But we will not achieve this improvement simply by devoting more time to the same things we have been doing for the past several decades. To improve students' thinking skills, we must make significant changes in our teaching and testing of those skills. We *can* make the necessary changes. But to do so, we must constructively deal with the obstacles that inhibit the effective learning of thinking skills in our classrooms.

---

1. "Thinking Skills, Achievement Ranked High in ASCD Planning Survey," *ASCD Update*, June 1983, pp. 2-3.
2. National Commission on Excellence in Education, *A Nation at Risk* (Washington, D.C.: U.S. Government Printing Office, 1983); *Academic Preparation for College: What Students Need to Know and Be Able to Do* (New York: College Board, 1983), pp. 9-10; and Gene I. Maeroff, "Teaching to Think: A New Emphasis," *New York Times Magazine*, 9 January 1983, Sect. 12, pp. 1, 37.
3. Barry K. Beyer, "Improving Thinking Skills – Defining the Problem," *Phi Delta Kappan*, March 1984, pp. 486-90.
4. Richard W. Burns and Gary D. Brooks, "Processes, Problem Solving, and Curriculum Reform," *Educational Technology*, May 1970, pp. 10-13.
5. Benjamin Bloom et al., eds., *Taxonomy of Educational Objectives – Handbook I: Cognitive Domain* (New York: David McKay, 1956).
6. See, for example, Barry K. Beyer, *Teaching Thinking in Social Studies* (Columbus, O.: Charles E. Merrill, 1979), pp. 42-57.
7. See, for example, Anna S. Ochoa, "Now, More Than Ever . . . Decision-Making and Related Skills," in Jack Allen, ed., *Education in the 80's: Social Studies* (Washington, D.C.: National Education Association, 1981), pp. 100-112.
8. Barry K. Beyer, "Common Sense About Teaching Thinking Skills," *Educational Leadership*, November 1983, p. 48.
9. Robert H. Ennis, "A Concept of Critical Thinking," *Harvard Educational Review*, Winter 1962, p. 84.
10. David Pratt, *Curriculum Design and Development* (New York: Harcourt Brace Jovanovich, 1980), pp. 312-14.
11. See, for example, John R. Hayes, *Cognitive Psychology: Thinking and Creating* (Homewood, Ill.: Dorsey Press, 1978), pp. 153-244; and Hilda Taba et al., *Thinking in Elementary School Children* (San Francisco: San Francisco State College, USOE Cooperative Research Project #1574, 1964).
12. Hayes, *Cognitive Psychology*. . . .
13. Harold Berlak, "The Teaching of Thinking," *School Review*, Spring 1965, pp. 1-13.
14. Edward de Bono, "The Direct Teaching of Thinking as a Skill," *Phi Delta Kappan*, June 1983, pp. 703-8; and Catherine Cornbleth and Willard Korth, "If Remembering, Understanding, and Reasoning Are Important. . . ," *Social Education*, April 1981, pp. 276, 278-79.
15. Michael I. Posner and Steven W. Keele, "Skill Learning," in Robert M. W. Travers, *Second Handbook of Research on Teaching* (Chicago: Rand McNally, 1973), pp. 805-31; Jack Lockhead and John Clement, eds., *Cognitive Process Instruction: Research on Teaching Thinking Skills* (Philadelphia: Franklin Institute Press, 1979); Arthur Whimbey and Linda Shaw Whimbey, *Intelligence Can Be Taught* (New York: E.P. Dutton, 1975); Barak V. Rosenshine, "Content, Time, and Direct Instruction," in Penelope L. Peterson and Herbert J. Walberg, eds., *Research on Teaching* (Berkeley: McCutchan, 1979), pp. 28-56; Peter H. Martorella, "Cognition Research: Some Implications for the Design of Social Studies Instructional Materials," *Theory and Research in Social Education*, Fall 1982, pp. 1-16; Thomas H. Estes, "Reading in Social Studies – A Review of Research Since 1950," in James L. Laffery, ed., *Reading in the Content Areas* (Newark, Del.: International Reading Association, 1972), pp. 178-83; and Benjamin S. Bloom, *Human Characteristics and School Learning* (New York: McGraw-Hill, 1976).
16. Arthur Whimbey, "Teaching Sequential Thought: The Cognitive-Skills Approach," *Phi Delta Kappan*, December 1977, p. 257.
17. Benjamin S. Bloom and Lois J. Broder, *Problem Solving Processes of College Students* (Chicago: University of Chicago Press, 1950).
18. Superintendent of Public Instruction, *Development of Problem Solving Skills for Vocational and Educational Achievement: Student Workbook* (Olympia: Washington State Department of Public Instruction, 1976), pp. 1-53; and Whimbey and Whimbey, pp. 53-59.
19. Beyer, "Common Sense. . . ," pp. 45-48.
20. Elliot W. Eisner, "The Kind of Schools We Need," *Educational Leadership*, October 1983, p. 54.
21. Ted Feeley, Jr., "Critical Thinking: Toward a Definition, Paradigm, and Research Agenda," *Theory and Research in Social Education*, August 1976, p. 12.
22. Matthew Lipman, *Harry Stottlemeier's Discovery* (Montclair, N.J.: First Mountain Foundation, n.d.); and Donald W. Oliver and James P. Shaver, *Teaching Public Issues in the High School* (Boston: Houghton Mifflin, 1966), pp. 114-81, 286-304.
23. Bryce B. Hudgins, *Learning and Thinking* (Itasca, Ill.: F.E. Peacock, 1977), pp. 142-72; Herbert J. Klausmeier and J. Kent Davis, "Transfer of Learning," *Encyclopedia of Educational Research* (New York: Macmillan, 1969), pp. 1438-93; and John McPeck, *Critical Thinking and Education* (New York: St. Martin's Press, 1981).
24. Posner and Keele, pp. 806-8, 820-22.
25. Feeley, pp. 7-8.
26. Theodore R. Sizer, "High School Reform: The Need for Engineering," *Phi Delta Kappan*, June 1983, p. 682. □

19 BEST COPY AVAILABLE

TEACHING FOR INTELLIGENT BEHAVIOR

by

Arthur L. Costa
Professor Educational Administration
California State University, Sacramento

Education's role in developing intelligence will best be realized when an integrated curriculum system is installed with the component parts tuned to work harmoniously to produce desired results. There are numerous interrelated domains of the curriculum: The ideal, the formal, the instructional, the operational, and the experimental (Klein, Tye & Wright, 1979). An historical view of curriculum change demonstrates the ineffectiveness of efforts when these components are not in "sync." Recent school effectiveness studies demonstrate what can happen when they are (Cohen, 1981). Decision makers at each of these hierarchical levels must act synergistically to generate a resurgent momentum for the "back to complexities" movement.

Following are fourteen suggested questions intended to stimulate inquiry into curriculum and instructional conditions necessary to develop intelligent behaviors. Some of the conditions are based on soft assumptions; others on hard data. It is not intended to be a complete and handy check list. Nothing worth teaching can ever be achieved in such a simplistic manner. They may, however, provide some cues to accelerate the dialogue.

1. Are intelligent behaviors valued as a goal of education?

Community values play an important role in influencing what is taught. In turn, teachers usually perform in a manner consistent with how they are valued. One basic condition for teaching towards intelligent behavior is that teachers, parents, administrators and board members adopt it as a basic goal of education. The demonstration of such a community-wide emphasis would be exhibited in several ways:

- —Instructional materials will be developed and adopted to enhance thinking.
- —Administrators will be trained in how to recognize and evaluate teachers on how well they promote thinking.
- —Staff development will be provided on how to describe, teach and measure thinking.
- —Problem solving will be heard as the subject of discussion and debate in faculty, parent and board meetings.
- —Monies will be allocated to increase it.
- —Community groups will complain that we're not doing enough of it.
- —There will be developed and installed a system for monitoring and assessing student's growth in thinking.
- —Parent education will be provided to foster and support thinking at home.
- —Incentives and rewards will be given to teachers, students and administrators who excel in intelligent behaviors.

2. **Do we believe that human intellectual capacity can be enhanced?**

Teacher expectations and preconceptions of student abilities are correlated with achievement (Cohen, 1981) (Good & Brophy, 1971). These preconceptions are generated and communicated with such labels as "learning disabled," "retarded," "below grade level," "deprived," "gifted," etc.

These preconceptions are further aggravated with the myth of a static and unchanging I.Q. Many educators still believe and act as if the score on a test is an accurate predictor of ability. Our expectations of students are influenced when magical numbers of 70 and 132 are mentioned.

Basic to teaching toward intelligent behavior is a philosophy that all human beings have the capacity for learning; that the ability to use intelligent behavior is never fully developed; and that the capacity for a more highly developed intellect continues throughout life. There are, of course, certain environmental, psychological or physiological factors present in a child's life which may contribute to intellectual underdevelopment. The teaching act, therefore, becomes one of compensating for those detriments.

With the adoption of such a faith, we will alter some of our stereotyping practices such as ability grouping, watering down the curriculum so that "slower" learners work at a "slower" pace on content with which they have already filed; or giving more of the same material faster to "gifted" students who already know performance or explored the limits of their mental capacities. We are all "retarded" and "gifted" in varying degrees.

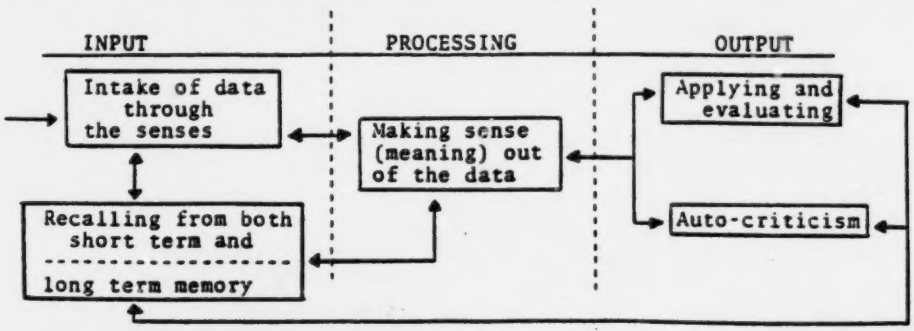
3. **Is there consensus on a model of human intellectual behavior?**

While there are numerous models of human intellectual functioning, it is probably more beneficial to spend time and energy understanding one or more of them rather than deciding which model and whose terminology is correct.

An examination of several models yields more similarities than differences. Most authors distinguish three basic thought clusters (Smith & Tyler, 1945). These are 1) an INPUT of data from the senses and from memory; 2) the PROCESSING of those data into meaningful relationships; and 3) the OUTPUT or application of those relationships to novel situations. A comparison of several authors' constructs follows:

DATA INPUT PHASE	PROCESSING PHASE	OUTPUT PHASE	SOURCE
Internal & External Input	Central Processing	Output	Atkinson & Shiffrin, 1968
Participation & Awareness	Internalization	Dissemination	Bell & Stainaker, 1979
Knowledge	Comprehension Analysis Synthesis	Application Evaluation	Bloom, 1956
Descriptive	Interpretive	Evaluative	Eisner, 1979 pp. 71-103
Input	Elaboration	Output	Feuerstein, 1980 pp. 71-103
Fluency	Manipulation	Persistence	Foshay, 1979 pp. 93-113
Cognition & Memory	Evaluation	Convergent & Divergent Production	Guilford, 1967
Fact	Concept	Value	Harmin, 1973
Receiving	Responding Valuing Organizing	Characterizing	Krathwohl, 1964
Alertness	Information Processing	Action	Restak, 1979 p. 44
Learning	Integrating	Applying	Sexton & Poling, 1973, p. 7
Intuitive	Awareness	Function	Strasser 1972 pp. 46-47
Intake Storage	Mediation	Action	Suchman, 1966
Concept Formation	Interpretation Inference	Application of Principals	Taba, pp. 30-38
Detailed Observation Recall of Previous Knowledge	Comparison	Rule Generation Auto Criticism	Whimbey, 1976 pp. 116-138

The following diagram, which omits such important concepts as affect, motivation and perceptual abilities, is a simplified attempt to provide a model of human intellectual functioning which could serve as a basis for curriculum and instruction.



BEST COPY AVAILABLE

A MODEL OF HUMAN INTELLECTUAL BEHAVIOR

by

Dr. Arthur Costa

A description of some of the capacities in each phase of input, processing and output would be as follows: (These rely heavily on Fuerstein's Instrumental Enrichment with adaptations from Bloom & Broder, 1950.)

I. GATHERING INFORMATION (INPUT)

A. Using the senses (listening, smelling, observing, tasting, feeling) to gather clear and complete information. (Perceiving clearly)

B. Using a system or plan to collect all relevant information rather than having to repeat observations. (Exploring systematically)

C. Naming the objects, conditions and events observed and experienced so that they can be remembered and talked about. (Labeling)

D. Describing objects, conditions and events in terms of where and when they occur. (Perceiving temporal and spatial relationships)

E. Identifying which characteristics of an object, event or condition which stay the same even when changes take place. (Conserving constancy)

F. Considering more than one variable at a time as a basis for organizing and reorganizing the information gathered. (Using more than one frame of reference)

G. Being precise and accurate.

II. MAKING SENSE OUT OF THE INFORMATION GATHERED (PROCESSING)

A. Defining what is the problem, what is needed to resolve the problem and what must be done to figure it out. (Analyzing discrepancies)

B. Discriminating among the information gathered that which is relevant and applicable and that which is not (Perceiving relevance)

C. Having a picture (image) in mind of what to look for and what must be done. (Interiorizing)

D. Making a plan or strategy which includes the steps needed to reach the goal. (Systematic planning)

E. Remembering the various pieces of information needed. (Broadening the mental field)

F. Searching for relationships among disparate objects, conditions, events, and past experiences. (Projecting relationships)

G. Finding similarities and differences among objects, conditions and events. (Comparing)

H. Finding the class or set to which a new object, condition or event belongs. (Categorizing)

I. Exploring alternative solutions and projecting what would happen if one or another were chosen. (Hypothesizing)

J. Defending an option with logical evidence.

K. Having a repertoire of problem solving strategies so that another can be used when one does not produce results. (Flexibility)

III. **APPLYING AND EVALUATING ACTIONS IN NOVEL SITUATIONS (OUTPUT)**

A. Communicating accurately and precisely. (Using precise language)

B. Expressing another person's ideas, point of view and feelings accurately. (Overcoming egocentrism)

C. Thinking through a solution or answer rather than making mistakes and having to repeat. (Overcoming trial and error)

D. Pausing to formulate an idea rather than blurting out the first answer that comes to mind. (Restraining impulsivity)

E. Having alternative strategies of finding answers when they are not immediately apparent rather than giving up in panic or dispair. (Overcoming blocking)

F. Checking to see if the results of the strategy (produce) matches intended outcome (image). (Checking for accuracy)

Applying this model, we shall now consider the types of teacher behaviors which facilitate the development of these intellectual behaviors.

4. **Do Students realize it is an objective?**

Teacher: "Why do you think Carl Sandburg repeated the last line of this verse?"
Student: (No response)

Teacher: (After a long pause) "Well, what feelings did you have as you read the poem?"
Student: "Why don't you just tell us the answer?" (Wassermann, 1978)

Students expend great amounts of energy trying to figure out the teacher's intentions. Because some students come from homes, previous teachers or other schools where intelligent behaviors were not valued, they often are dismayed by and resistant to a teacher's invitation to think. Such resistance and reluctance to respond should be taken as an indication that a program to develop intellectual skills is needed.

Teachers must emphasize to students that the goal of instuction is thinking; that the reponsibility for thinking is theirs; that it is desirable to have more than one solution; that is commendable when they take time to plan and to think; and that an answer can be changed with additional information.

Regardless of how often teachers make the objectives of thinking explicit, several other implicit teacher behaviors will communicate this goal even more effectively.

5. **Does the teacher's language invite it?**

Based on the model in 3 above, information taken in is constantly interpreted in terms of what is already known. If new information can be easily understood with familiar knowledge, no problem or challenge exists (Assimilation). If, however, the new information cannot be explained or resolved with the knowledge in short- or long-term memory, a discrepancy is perceived. The information must be processed, action taken to gather more information to resolve the discrepancy and the ultimate resolution tested for its "fit" with reality (Accommodation). Thus, a problem may be defined as a stimulus or challenge to which the response is not readily apparent.

The teacher, crucial as a mediator of intelligent behavior, calls attention to discrepancies and poses problems intended to invite more than a memory type response. Embedded in the teacher's questions and other statements are the cues for student's cognitive perfomrance (Davis & Tinsley, 1967; Andre, 1979; Lowery, 1980). Teacher's questions can cause a lifting from one level of cognition to a higher level (Taba, Levine, & Elzey, 1964).

6. **Are instructional activities arranged sequentially?**

"A child learns first to recognize a rectangle by abstracting the features of many particular rectangles and then applying this knowledge to future situations (Restak, 1979, p. 299)."

Bloom, Taba, Bruner, Piaget and others have helped us see that these levels of thinking are cumulative. It may be counterproductive for the teacher to invite processing or output thinking tasks without providing adequate time and experience at the input, data accumulation levels. If the student has had inadequate input from memory, experience or sensory stimulation, there will be inadequate data with which to perceive discrepancies and, therefore, to function at the processing level. If those data are not processed and integrated by comparing, exploring casual relationships, sequencing, etc., the higher levels of thinking will be performed with little quality or substantive attendant content.

This model can thereby be used as a diagnostic tool to observe and analyze student's thinking performance. If a teacher's question, statement or problem focus indeed produces cognition at the level intended, there is a match. If, however, the level of student's thinking elicited is inconsistent with the teacher's intended level of intellectual functioning, or if no discrepancy in the problem is perceived, there is a mismatch. Noting this, the teacher can adjust the level and complexity of the cognitive task to one or more appropriate to the student's current level of intellectual functioning and remain at that level until enough data is gathered or the data is processed sufficiently before moving to higher levels productively.

7. **Do teacher's responsive behaviors enhance and extend intelligent behavior?**

Much of students' cueing comes not from the question or statement but rather from the teacher's response behaviors. How students anticipate the teacher will respond to their answers may exert greater influence on their answers than the question which the teacher asked. If a teacher reacts to a student's answer with a response that signals conformity—praise (Brophy, 1979), corrective feedback, criticism or other value judgments (Rowe, 1974)—students will soon realize that their individual thinking is not valued as much as correctly guessing what the teacher had in mind.

Responsive behaviors which seem to facilitate intellectual functioning are: silence after having asked a question or after a student responds (Rowe, 1974); accepting, building upon, integrating and extending student's ideas (Flanders, 1969); clarifying (Klevin, 1958); and providing additional information (Andre, 1979 & Suchman, 1966). Such behaviors seem to create a stress free, cooperative classroom condition where experimental ideas can be risked, alternative hypotheses explored, answers changed with additional data; where more value is place on creative problem solving strategies rather than on conformity to "right" answers.

8. **Do the materials of instruction support it?**

Because the "medium is the message," our materials of instruction communicate educational values. If materials are designed to be read, memorized and tested, then this is the concept of schooling which students will derive. If, however, materials are organized and articulated through the grades and across the content areas with common and recurring intellectual goals, they can, over time, convince the learner that thinking is valued.

The development and/or adoption of instructional materials, therefore, must be made because of their contribution to and development of those intellectual skills described in the model of intellectual functioning. The range of available instructional materials runs the gamut from those that make hopeful claims that intelligent behaviors will result from their use; through those that utilize a content vehicle such as math (e.g., Curriculum Development Associates, Inc.), science (e.g., Science Curriculum Study) or social studies (e.g., Curriculum Development Associates', Man: A Course of Study, Holt's Data Bank) to experience and apply the behaviors; to those that are expressly designed to focus on and deliberately develop one or more of the cognitive skills, e.g., Benefic Press' Thinking Skills Development Program, Innovative Science Institute's THINK, and Feuerstein's Instrumental Enrichment from Curriculum Development Associates, Inc.).

9. **Is adequate instructional time devoted to developing thinking?**

While much research has demonstrated that achievement (in basic skills at certain grade levels as measured by standardized tests) correlates highly with the amount of time students are successfully engaged in learning (Borg, 1980), this same proposition would undoubtedly hold true for teaching intelligent behaviors as well.

The way we use our time is a reflection of our value system. If the development of intelligent behaviors is to achieve a high value in our schools, high priority and substantial time must be allocated with students and teachers engaged in it productively. The intellect, much like the musculature, needs constant exercise over extended periods of time, to perform with efficiency, synergy and fluid grace.

10. **Does instruction provide for differences in modality strengths?**

"I hear and I forget; I see and I remember; I do and I understand (Old Chinese Proverb)." Because some students are visiles, and some audiles (Barbe & Swassig, 1979, Dunn & Dunn, 1978), we realize that the input, processing and output phases of thinking must also incorporate the student's modality preference. When a teacher asks a question, it is usually posed orally and is responded to verbally by one student at a time. Anderson and Faust (1973, Ch. 6) contend, however, that a question will not have an instructional effect unless a student actually makes a response. The response may be overt or covert. Thus, teachers' questions may appeal and be responded to by mainly auditory learners. Some students will need to intake and process the data, then apply those relationships experientially, others visually, some auditorily, and for some, in all three modalities.

Furthermore, some students respond better in group settings, others individually or one-to-one. Posing questions and problems for small group resolution causes a friction against other minds when students must examine various points of view, achieve consensus and compare and evaluate alternative decisions.

Thus, by providing alternative grouping practices, by providing a visually, auditorily and experientially stimulating environment (input), by providing manipulatives and discussion (processing) and alternative modes of expression (output) (e.g., visual dramatization, construction), it increases the opportunities for more students to become involved in exercising their intellectual capacities.

11. **Are modalities sequenced according to development theory?**

Psychobiologists have found strong support for Piagetian theories of cognitive development. New information is processed on the right side of the brain and begins with action and perception. As the information becomes familiar, it is then processed on the left side of the brain and proceeds to words and concepts (Restak, 1979, p. 217 & pp. 255-264). Too often, educational practice ignores or reverses this sequence of learning. Probably the true cause of failure (according to Piaget) in formal education is that we begin with language rather than with real and material action.

Again, the teacher's role as mediator of this sequence is crucial in providing direct, concrete experiences first, then mediating that experiences by inviting students to think about what they see and do, then by inviting oral language by talking about what they saw and did, then writing.

12. **Do students and teachers discuss their thinking?**

When children enter the concrete operations stage, they develop a conscious awareness of self interacting with a real, objectively verifiable world. During this stage, they develop inner language. As they enter the formal-logical stage, another uniquely human capacity emerges; the ability to stand away from, reflect on and evaluate one's own behavior. Binet referred to this as "auto-criticism" (Whimbey, 1976, pp. 116-138).

Much evidence suggests that causing students to talk about their thinking processes and strategies of problem solving during introspection) and after (retrospection) enhances their ability to think. Evidently thinking and talking about thinking begets thinking (Strasser, 1972, pp. 63-65; Link, 1980; Whimbey, 1980; Bloom & Broder, 1950).

13. **Do evaluation measures assess intelligent behavior?**

Most learning is evaluated with paper and pencil criterion-referenced or norm-referenced tests of what has been stored in short-or long-term memory. While it is easy to construct good test items to measure lower level cognitive skills, it is much more difficult to design items that measure higher-order mental processes (Metfessel & Michael, 1973). Because of this difficulty and because of the format (mostly multiple choice) of standardized achievement tests, intelligent behaviors are often not measured (Eisner, 1979, p. 181).

Probably the main problem that has plagued educational assessment is that it has not separated the effect of instruction on the acquisition of objectives covered in a lesson from the concepts, meanings and intellectual functions not covered in a lesson (Andre, 1979). Thus, the focus has been on learning of the objectives, not learning from the objectives.

If growth in intellectual behavior is to be evaluated, we must reconceptualize our approach to assessment: the testing situations, instruments, processes, products and interpretations. Individual cognitive maps displaying deficiencies and peaks in intellectual capacities would replace test scores. Teacher-observers would interact with the student to diagnose their abilities. The test itself would be a learning experience starting with real and concrete problems and advancing to more abstract complex tasks. Longitudinal study would seek evidence of student's increased spontaneous and autonomous use of the behaviors cited in 3 above. Thus, the product of assessment would not be what answers the student knows but how the student behaves when he/she doesn't know. We would search for indicators of a shift FROM the attitude that reasoning has little value, that an answer is either known or it is not, that the first idea that comes to mind is as good as any other, TO the viewing of problems as challenging, finding fun in reasoning thus doing it voluntarily. For example:

From	To .
INPUT	
(Example: Exploring Systematically)	
Exhibits difficulty in ascertaining what is required. Gives inadequate attention to directions; is careless with details and haphazard with approach to solution. If unable to solve a problem, gives up in dispair.	Demonstrates a systematic plan of attack. Takes time and makes directed effort. If unable to solve problem as a whole, perseveres with such strategies as breaking problem into parts.
PROCESSING	
(Example: Perceiving Relevance)	
Is unable to bring forth relevant information and knowledge to bear on problem solution; perceives no relatiohship between present and previous problem situations.	Commands the basic information necessary for the solution as well as the the ability to bring this knowledge forth in attacking problem.
OUTPUT	
(Example: Overcoming Egocentrism)	
Introduces personal considerations into problem solving. Is unable to extract subjective feelings and opinions from probem solution.	Reasons systematically and provides evidence with logic. Expresses confidence in problem solution.

14. **Do significant adults model intelligent behaviors?**

With imitation being a most basic form of learning, teacher's, parent's and administrator's modeling of desired intellectual behaviors is requisite to student performance (Bandura, 1962; Belcher, 1975). Thus, in day-to-day events and when problems arise in schools and classrooms, students must see adults employing the same types of behaviors identified above.

O.J. Harvey (1966) describes pesonalities in a sequence of categories (similar to Piaget's) ranging from what he called "concrete functioning behaviors" to "abstract functioning behaviors." The University of Califnornia at Berkeley Education Research and Applications program, found that abstract functioning teachers seem to be most suited to the profession of teaching while concrete functioning teachers seem to be detrimental to effective teaching (Lowery, 1981).

Some classroom examples of abstact teacher behaviors consistent with successful intellectual functioning might be:

INPUT	(Perceiving Clearly)	Being sensitive to subtle clues in Student behaviors.
	(Systematic Planning)	Planning for instruction.
PROCESSING	(Flexibility)	Considering alternative teaching strategies.
	(Logical Evidence)	Using information and expertise as guidelines for beliefs and judgments rather than using power, rewards and punishment.
OUTPUT	(Overcoming Egocentrism)	Taking a student's point of view.
	(Restraining Impulsivity)	Using reason and patience in dealing with discipline problems.

It is believed that this concept has great implications for teacher selection, training, evaluation and staff development.

In Summary

This list of fourteen questions is double the number of variables with which the typical human brain is capable of dealing at any given time (Miller, 1956, pp. 81-97). Curriculum leaders are invited to consider these, to relate them to their own experience, to explore the meaning and consequences of each and to apply and evaluate them in their own situation. Perhaps this can contribute to a more intelligent approach to curriculum chance.

> "...The level of the development of a country is determined, in considerable part, by the level of development of its people's intelligence..."
>
> Luis Alberto Machado
> October, 1980
> Peking, China

REFERENCES

Anderson, R. C. and Faust, G. W. Educational Psychology. New York: Dodd Mead, 1973.

Andre, T. "Does Answering Higher-Level Questions While Reading Facilitate Productive Learning?" Review of Educational Research. Spring, 1979. Vol.49, No. 2, pp. 280-318.

Atkinson, R. C. and Shiffren, R. M. "Human Memory: A proposed System and Its Control Process." In K. W. Spence and J. T. Spence (Eds.) The Psychology of Learning and Motivation (Vol. 2). New York: Academic Press, 1968, pp. 90-195.

Bandura, A. "Social Learning Through Imitation." In M. R. Jones (Ed.) Nebraska Symposium on Motivation. Lincoln: University of Nebraska Press, 1962, pp. 211-269.

Barbe, W. and Swassing, R. Teaching Through Modality Strengths: Concepts and Practices. Columbus: Zaner-Bloser, Inc. 1979.

Belcher, T. "Modeling Original Divergent Responses: An Initial Investigation." Journal of Educational Research. Vol. 67, #3, 1975, 351-358.

Bell, M. and Steinaker, N. The Experiental Taxonomy: A New Approach to Teaching and Learning. New York: Academic Press, 1979.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., and Krathwohl, D. R. Taxonomy of Educational Objectives: Handbook I: Cognitive Domain. New York: David McKay, 1956.

Borg, V. R. "Time and School Learning" in Denham C. and Lieberman, A. (Eds.) Time to Learn. Washington, D.C.: National Institute of Education, 1980, pp. 43-72.

Brophy, J. E. Teacher Praise: A Functional Analysis. East Lansing: Michigan State University Institute for Research on Teaching. Occasional Paper No. 28. October, 1979.

Bruner, J. Goodnow, J. J. and Austin, G. A. A Study of Thinking. New York: Wiley, 1956.

Cohen, M. "Effective Schools: What the Research Says." Today's Education. Vol. 70, No. 2. April-May, 1981, pp. 44-47.

Coker, H., Medley, D. and Soar, R. "How Valid Are Expert Opinions About Effective Teaching?" Phi Delta Kappan. Vol. 62, Od, 1980, pp. 131-135.

Davis, O. and Tinsley, D.C. "Cognitive Objectives Revealed by Classroom Questions Asked by Social Studies Teachers." Peabody Journal of Education. 45 (1), pp. 21-26.

Dunne, R. and Dunne, K. Teaching Students Through Their Individual Learning Styles. Reston: Reston Publishing Co., 1978.

Eisner, E. The Educational Imagination. New York: Macmillan Co., 1979.

Feuerstein, R. Instrumental Enrichment. Baltimore: University Park Press, 1980.

Flanders, N. A. Quorws in "Teacher Effectiveness." Encyclopedia of Educational Research. 4th Edition. Ebel, R. (Rd.) New York: Macmillan Co., 1969, pp. 1426-1429.

Foshay, A. W. "Toward a Humane Curriculum." in Jelenek, J. J. (Ed.) Education in Flux: Implictions for Curriculum Development. Tempe: University of Arizona Press, 1979, pp. 93-113.

Good, T. and Brophy, J. "The Self-Fulfilling Prophecy." Todays Education. April, 1971, pp. 52-53.

Guilford, J. P. The Nature of Human Intelligence. New York: McGraw-Hill, 1967.

Harmin, M., Kirschenbaum, H., and Simon, S. Clarifying Values Through Subject Matter. Minneapolis: Winston Press, Inc. 1973.

Harvey, O. J. "System Structure, Flexibility and Creativity." in O. J. Harvey (Ed.). Experience, Structure and Adaptability. New York: Springer, 1966, pp. 39-65.

Klein, F., Tye, K., and Wright, J. "A Study of Schooling: Curriculum." Phi Delta Kappan. December, 1979, pp. 244-248.

Klevin, A. "An Investigation of a Methodology for Value Clarification: Its Relationship to Consistency of Thinking Purposefulness, and Human Relations." Ph.D. Dissertation. New York University, 1958.

Krathwohl, D., Bloom, B. A. and Masia, B. B. Taxonomy of Educational Objectives Handbook II: Affective Domain. New York: David McKay Co., Inc. 1964.

Link, F. R. "Instrumental Enrichment: The Classroom Perspective." Educational Forum. Vol. ELIV, No. 4. May, 1980, pp. 425-428.

Lowery, L. and Marshall, H. Learning About Instruction: Teacher-initiated Statements and Questions. Berkeley: University of California, 1980.

Lowery, L. "Screening" Unpublished Manuscript. Berkeley: University of California Educational Research and Applications Programm, 1981.

Metfessel, N. S. and Michael, W. B. "A Paradigm Involving Multiple Criterion Measures for the Evaluation of the Effectiveness of School Programs." in Worthern, B. R. and Sanders, J. R. Educational Evaluation: Theory and Practice. Belmont: Wadsworth Publishing Co., 1973, pp. 269-289.

Miller, G. A "The Magical Number Seven, Plus or Minus Two: Some limits in our Capacity for Processing Information." Psychological Review. 63: pp. 81-97. March, 1956.

Restak, R. The Brain: The Last Frontier. New York: Warner Books, 1979.

Rowe, M. B. "Wait Time and Rewards as Instructional Variables: Their Influence on Language, Logic, and Fate Control." Journal of Research in Science Teaching. Ch. 11, pp. 81-94.

Sexton, T. G. and Poling, D. R. Can Intelligence be Taught? Bloomington: Phi Delta Kappa Educational Foundation Fastback Series #29, 1973.

Smith, E. R. and Tyler, R. W. Appraising and Recording Student Progress. New York: Harper, 1942.

Strasser, B. B. et al. Teaching Toward Inquiry. Washington, D.C.: National Education Association, 1972.

Suchman, J. R. "A Model for the Analysis of Inquiry." In Analyses of Concept Learning. New York: Academic Press, Inc. Ch. 11, 1966, pp. 177-187.

Taba, H., Levine, S. and Elzey, F. Thinking is Elementary School Children. Cooperative Research Project. No. 1574. San Francisco State College, 1964.

Walker, D. Presentation to the Select Curriculum Committee of 75. Association for Supervision and Curriculum Development, National Convention, March 8, 1981, St. Louis, Missouri.

Wasserman, S. Put Some Thinking in Your Classroom. Chicago: Benefic Press, 1978.

Whimbey, A. and Whimbey, L. S. Intelligence Can be Taught. New York: Bantam Books, 1976.

Wimbey, A. "Students Can Learn to be Better Problem Solvers." Educational Leadership. Vol. 37, No. 7, April, 1980, pp. 56-565.

Winne, P. H. "Experiments Relating Teacher's Use of Higher Cognitive Questions to Student Achievement." Review of Educational Research. Winter, 11979, Vol. 49, No. 1., pp. 13-50

*Reprinted with author's permission.

TEACHING THINKING SKILLS - AN INCLUSION PROCESS

By
Antoinette M. Worsham, Ph.D
Educational Specialist for Language Arts

Howard County Public School System
10910 Route 108
Ellicott City, Maryland 21043

While research has shown that nearly all students beyond the age of twelve should be able to reason at the formal operational level (Piaget, 1972), less than 40% of high school graduates are able to demonstrate higher-level thinking skills (Day, 1981). The reason many students fail in the performance of assigned tasks seems to be due, not to a lack of information regarding the principles involved or to low intelligence, but rather, to an inability to apply the underlying skills upon which successful thinking depends (Makler, 1980).

However, studies also indicate that a student's ability to think more effectively can be improved through direct instruction (Whimbey and Whimbey, 1971; Worsham and Austin, 1983). Whimbey's research in cognitive skill development (1980) indicates that if students are taught basic thinking skills and given practice in using them and verbalizing their usage, their overall ability to think and solve problems will improve. The Worsham study (1982) showed students improving an average of 42 points on the verbal portion of the SAT after three consecutive semesters of instruction in thinking skills. Thinking skills instruction comprised two-fifths of the total English program during their junior and senior years.

Data from recent research, then, provide educators with a firm basis for shifting instructional emphases from teaching information to developing thinking skills. But how to do it most effectively has become a major issue of debate among educators.

The Problem is a complex one which raises such questions as:

- What do we mean by thinking skills?
- Should these skills be taught apart from content or incorporated into the existing curriculum?
- Which skills should be taught?
- Are we clear in our own understanding of these skills?
- Can we come to a consensus regarding precise definitions and the sequence of steps involved in the application of each skill we teach?
- How do we evaluate student progress in mastering thinking skills?

Until we can answer these questions it is doubtful that we will succeed in helping our students to become better thinkers.

A procedural framework which seems appropriate in addressing these issues is the following inclusion process:

1. Develop or select an acceptable list of thinking skills.
2. Choose those specific skills from the list which are necessary for mastering the curriculum.
3. Define each skill.
4. Determine and list the steps involved in the application of each skill.
5. Apply the skills at the appropriate point(s) in the curriculum.
6. Test for mastery of each skill.

<u>Develop/Select a List of Skills</u>

There are numerous lists of thinking skills available ranging in length from as few as six to as many as Guilford's 120 mental abilities. The problem of which list to choose is best solved by considering the nature of the content to be taught and determining which list includes

most of the skills needed to master that content. In the area of secondary language arts, for example, an appropriate list might include such skills as: finding the main idea, identifying supporting details, distinguishing fact from opinion, classifying and catagorizing information, making inferences, distinguishing between literal and figurative meanings, predicting outcomes, drawing conclusions, analyzing information, and evaluating generalizations.

Choose Specific Skills

After the listing has been either developed or selected, a careful analysis should be made of the actual curriculum to be taught to determine which specific skills are requisites or prerequisites to learning that content. These skills should then be taught as integral components of the curriculum. Restraint must be exercised regarding the number of skills selected. It is far better to select a few skills (one per month or one per unit) that are needed in various segments of the total curriculum than to attempt to cover as many of the skills as possible.

Define Each Skill

Before a thinking skill can be understood it must be defined by both the teacher and the student. The process of defining is itself, a skill which requires thoughtful analysis. For the teacher merely to define the skill for the students reduces the students involvement to one of memorization. It is just as important for the students to go through the defining process as it is for the teacher. A mechanism for reaching consensus might also be necessary if the definitions generated are too diverse. However, a refining process is usually all that is needed to come up with a definition acceptable to all.

List the Steps Involved in Applying The Skill

After the definition is developed, a list of those mental procedures necessary to apply the skill can best be determined by using the skill with a curricular problem. For example, if the thinking skill selected is "predicting outcomes" and the students have agreed upon the definition "to make some valid guess about what might happen based upon known facts," they might then generate a listing of steps necessary to predict an outcome such as the following:

1. Collect data.
2. Search for patterns (classify).
3. Infer cause-effect relationships.
4. Construct a statement concerning an unknown event based upon the pattern of known events (predict).
5. Evaluate the prediction.
6. Seek alternatives.

It is useful to have each student work independently at first and then in pairs or in groups to further refine the steps.

Apply the Skill

The practical application of this procedure to actual content which requires the particular skill studied should follow immediately so that the students can see how well their steps work and decide whether further modifications need to be made in their listing. Ideally, the students would have numerous opportunities to apply the problem-solving procedure so that they become more and more proficient in applying the steps.

Testing for Mastery

Finally, just as the content is tested so should the thinking skill be tested. That is, the final test should require that students demonstrate the ability to apply the thinking skill taught during the unit.

To master thinking skills requires practice and reinforcement. The middle school setting is particularly appropriate for this thinking skill inclusion process because a team of teachers from the various content areas works with the same group of students and, during team planning periods, can determine what thinking skills to teach and then arrange the sequencing of their various contents wherever possible so that the same skill is being studied simultaneously in each subject area.

This process not only provides students with the practice and reinforcement they need for mastery but also helps them to see that the same cognitive procedures that are used in solving a math problem also may be used to conduct a science experiment or predict an event in history. While this process is simple in concept it is difficult to implement because the content and thinking process must be carefully matched so that one complements the other. Thinking time and opportunities for students to articulate their thought processes must be provided. Less content will be covered but at a far greater cognitive level. We will be equipping our students with the tools of learning rather than innudating them with the facts of knowledge. In other words, they will be learning to learn.

As educators, we, ourselves, need practice in this approach to teaching and learning. The "how" of learning must become the focus of our instruction rather than the far more comfortable and measurable knowledge-level learning which currently constitutes the greatest portion of instructional time in the classroom.

References

Day, M.C. "Thinking at Piaget's Stage of Formal Operations." Educational Leadership, October, 1981, pp. 44-47.

Makler, S.J. "On Instructional Enrichment. A Conversation with Frances Link." Educational Leadership, April, 1980, pp. 569-571, 582.

Piaget, J. "Intellectual Evolution From Adolescence to Adulthood." Human Development, 1972, 15, pp. 1-12.

Worsham, A.M. & Austin, G.R. "Effects of Teaching Thinking Skills on SAT Scores." Educational Leadership, November, 1983, pp. 50-51.

Worsham, Antoinette M. "The Fffects of Think - A Language Arts Thinking Skills Program on Scholastic Aptitude Tests (SAT) Verbal Scores at a Baltimore City Senior High School." Unpublished doctoral dissertation, University of Maryland, 1982.

MEDIATING THE META-COGNITIVE 8-28rev

by Arthur L. Costa
Professor of Education
California State University, Sacramento

Try to solve this problem in your head:

How much is one half of two plus two?

Did you hear yourself talking to yourself? Did you find yourself having to decide if you should take one half of the first two (which would give the answer, three) or if you should sum the two's first (which would give the answer, two)?

If you caught yourself having an "inner" dialogue inside your brain, and if you had to stop to evaluate your own decision making/problem-solving processes, your were experiencing META-COGNITION.

Occurring in the neo-cortex and therefore thought by some neurologists to be uniquely human, meta-cognition is our ability to know what we know and what we don't know. It is our ability to plan a strategy for producing what information is needed, to be conscious of our own steps and strategies during the act of problem solving, and to reflect on and evaluate the productiveness of our own thinking. While "inner language", thought to be a prerequisite, begins in most children around age five, meta-cognition is a key attribute of formal thought flowering about age eleven. Interestingly, not all humans achieve the level of formal operations (Chiabetta, 1976). And as Alexander Luria, the Russian psychologist found, not all adults meta-cogitate (Whimbey, 1976).

"THE TROUBLE WITH MARGARET IS, THAT WHEN SHE KNOWS, SHE *KNOWS* SHE KNOWS!"

We often find students following instructions or performing tasks without wondering why they are doing what they are doing. They seldom question themselves about their own learning strategies or evaluate the efficiency of their own performance. Some children virtually have no idea of what they should do when they confront a problem and are often unable to explain their strategies of decision making. (Sternberg and Wagner, 1982) There is much evidence, however, to demonstrate that those who perform well on complex cognitive tasks, who are flexible and perserverent in problem solving, who conciously apply their intellectual skills, are those who possess well developed meta-cognitive abilities (Bloom, & Broder, 1950), (Brown, 1978), (Whimbey, 1980). They are those who "manage" their

intellectual resources well: 1) their basic perceptual-motor skills; 2) their language, beliefs, knowledge of content, and memory processes; and 3) their purposeful and voluntary strategies intended to achieve a desired outcome (Aspen Institute, 1982).

If we wish to install intelligent behavior as a significant outcome of education, then instructional strategies, purposefully intended to develop childrens' meta-cognitive abilities, must be infused into our teaching methods, staff development, and supervisory processes (Costa, 1981). Interestingly, DIRECT instruction in meta-cognition may NOT be beneficial. When strategies of problem solving are imposed by the teacher rather than generated by the students themselves, their performance may become impaired. Conversely, when students experience the need for problem solving strategies, induce their own, discuss and practice them to the degree that they become spontaneous and unconsious, their meta-cognition seems to improve (Sternberg and Wagner, 1982). The trick, therefore, is to teach meta-cognitive skills without creating an even greater burden on their ability to attend to the task.

Problably the major componants of meta-cognition are developing a plan of action, maintaining that plan in mind over a period of time, then reflecting back on and evaluating the plan upon its completion. Planning a strategy before embarking on a course of action assists us in keeping track of the steps in the sequence of planned behavior at the conscious awareness level for the duration of the activity. It facilitates making temporal and comparative judgments, assessing the readiness for more or different activities, and monitoring our interpretations, perceptions, decisions and behaviors. An example of this would be what superior teachers do daily: developing a teaching strategy for a lesson, keeping that strategy in mind throughout the instruction, then reflecting back upon the strategy to evaluate it's effectiveness in producing the desired student outcomes.

Rigney, (1980) identified the following self-monitoring skills as necessary for successful performance on intellectual tasks:

Keeping one's place in a long sequence of operations,

Knowing that a subgoal has been obtained, and

Detecting errors and recovering from those errors either by making a quick fix or by retreating to the last known correct operation.

Such monitoring involves both "looking ahead" and "looking back". Looking ahead includes:

Learning the structure of a sequence of operations,

Identifying areas where errors are likely,

Choosing a strategy that will reduce the possibility of error and will provide easy recovery,

Identifying the kinds of feedback that will be available at various points, and evaluating the usefulness of that feedback.

Looking back includes:

Detecting errors previously made,

Keeping a history of what has been done to the present and thereby what should come next, and

Assessing the reasonableness of the present immediate outcome of task performance.

A simple example of this might be drawn from a reading task. It is a common experience while reading a passage to have our mind "wander" from the pages. We "see" the words but no meaning is being produced. Suddenly we realize that we are not concentrating and that we've lost contact with the meaning of the text. We "recover" by returning to the passage to find our place, matching it with the last thought we can remember, and once having found it, we read on with connectedness. This inner awareness and the strategy of recovery are componants of meta-cognition.

STRATEGIES FOR ENHANCING META-COGNITION *

Following are a dozen suggestions that teachers of any grade level can use to enhance meta-cognition. Whether teaching vocational education, physical education, algebra, or reading skills, teachers can promote meta-cognition by using these and similar instructional techniques.

1. STRATEGY PLANNING.

PRIOR to any learning activity, teachers will want to take time to develop and discuss strategies and steps for attacking problems, rules to remember, and directions to be followed. Time constraints, purposes, and groundrules under which students must operate should be developed and "interiorized". Thus, students can better keep these in mind during and evaluate their performance after the experience.

DURING the activity, teachers can invite students to share their progress, thought processes, and perceptions of their own behavior. Asking students to indicate where they are in their strategy, to describe the "trail" of thinking up to that point, and what alternative pathways they intend to pursue next in the solution of their problem, helps them become aware of their own behavior. (It also provides the teacher with a diagnostic "cognitive map" of the student's thinking which can be used to give more individualized assistance.)

---

* For several of these techniques I am deeply indebted to Fred Newton, Multnomah County, (Oregon) Superintendent of Schools Office; Juanita Sagan, a therapist in Oakland, California; and Ron Brandt of A. S. C. D.

Then, AFTER the learning activity is completed, teachers can invite students to evaluate how well those rules were obeyed, how productive were the strategies, whether the instructions were followed correctly, and what would be some alternative more efficient strategies to be used in the future.

I know a Kindergarten teacher who begins and ends each day with a class meeting. During these times, children make plans for the day. They decide upon what learning tasks to accomplish and how to accomplish them. They allocate classroom space, assign roles, and develop criteria for appropriate conduct. Throughout the day the teacher calls attention to the plans and groundrules made that morning and invites students to compare what they are doing with what was agreed. Then, before dismissal, another class meeting is held to reflect on, evaluate, and plan further strategies and criteria.

2. QUESTION GENERATING

Regardless of the subject area, it is useful for students to pose study questions for themselves prior to and during their reading of textual material. This self-generation of questions facilitates comprehension. It encourages the student to pause frequently and perform a "self-check" for understanding, to detgermine whether or not comprehension has occurred. If, for example: they know the main characters or events; they are grasping the concept; if it "makes sense", if they can relate it to what they already know, if they can give other examples or instances, if they can use the main idea to explain other ideas; or if they can use the information in the passage to predict what may come next. They then must decide what strategic action should be taken to remove obstacles to and thereby increase comprehension. This helps students become more self-aware and to take conscious control of their own studying. (Sanacore, 1984)

3. CONSCIOUS CHOOSING.

Teachers can promote meta-cognition by helping students explore the consequences of their choices and decisions prior to and during the act of deciding. Students will then be able to perceive causal relationships between their choice, their actions, and the results they achieved. Providing non-judgmental feedback about the effects of their behaviors and decisions on others and on their environment helps students become aware of their own behaviors. For example, a teacher's statement, "I want you to know that the noise you're making with your pencil is disturbing me," will better contribute to meta-cognitive development than the command, "John, stop tapping your pencil!"

4. DIFFERENTIATED EVALUATING.

Teachers can enhance meta-cognition by causing students to reflect upon and categorize their actions according to two or more sets of evaluative criteria. An example would be inviting students to dis-

tinguish what was done that day that was was helpful and hindring; what they liked and didn't like; or what were plusses and minuses of the activity. Thus, students must keep the criteria in mind, apply them to multiple classification systems, and justify their reasons accordingly.

5. TAKING CREDIT.

Teachers may cause students to identify what they have done well and invite them to seek feedback from their peers. The teacher might ask, "What have you done that you're proud of?" "How would you like to be recognized for doing that?" (Name on the board, hug, pat on the back, handshake, applause from the group, etc.) Thus students will become more conscious of their own behavior and apply a set of internal criteria for that behavior which they consider "good".

6. OUTLAWING "I CAN'T".

Teachers can inform students that their excuses of "I can't," "I don't know how to....", or "I'm too slow to....." are unacceptable behaviors in the classroom. Rather, having students identify what information is required, what materials are needed, or what skills are lacking in their ability to perform the desired behavior is an alternative and acceptable response. This helps students identify the boundaries between what they know and what they need to know. It develops a perserverent attitude and enhances the student's ability to create strategies that will produce needed data.

7. PARAPHRASING OR REFLECTING BACK STUDENTS' IDEAS.

Paraphrasing, building upon, extending, and using students' ideas can make them consious of their own thinking. Some examples might be by saying: "What your telling me is...," or "What I hear in your plan are the following steps...," or "Let's work with Peter's strategy for a moment."

Inviting students to restate, translate, compare, and paraphrase each other's ideas causes them to become not only better listeners of other's thinking, but better listeners to their own thinking as well.

8. LABELING STUDENTS' BEHAVIORS.

When the teacher places labels on students' cognitive processes, it can make them conscious of their own actions: "What I see you doing is making out a plan of action for..." "What you are doing is called an experiment." "You're being very helpful to Mark by sharing your paints. That's an example of cooperation."

9. CLARIFYING STUDENTS' TERMINOLOGY.

Students often use "hollow," vague, and non-specific terminology. For example, in making value judgments students might be heard saying, "It's not fair....", He's too strict..." "It's no good...". Teachers need to get in the habit of clarifying these values: "What's TOO strict?" "What would be more fair?"

We sometimes hear students using nominalizations: "They're mean to me..." "Who are they?" "We had to do that...." "Who is we?" "Everybody has one...." "Who is everybody?" Thus, clarifying causes students to operationally define their terminology and to examine the premise on which their thinking is based. It is desirable that, as a result of such clarifying, students would become more specific and qualifying in their terminology.

For older children, above age eleven or so, it appears helpful to invite them to clarify their problem solving processes. Causing them to describe their thinking while they are thinking seems to beget more thinking. Some examples might be: inviting a student to talk aloud as he or she is solving a problem; discussing what is going on in their head, for example, when they confront an unfamiliar word while reading; or what steps they are going through in deciding whether to some article at the store.

After solving a problem, the teacher can invite a clarification of the processes used: "Sarah, you figured out that the answer was 44; Shawn says the answer is 33. Let's hear how you came up with 44; retrace your steps for us." Thus clarifying helps students to re-examine their own problem-solving processes, to identify their own errors and to self-correct. The teacher might ask a question such as: "How much is three plus four?" The student may reply, "12". Rather than merely correcting the student, the teacher may choose to clarify: "Gina, how did you arrive at that answer?" "Well, I multiplied four and three and got.....Oh, I see, I multiplied instead of added."

10. ROLE PLAYING AND SIMULATIONS.

Having students assume the roles of other persons causes them to consiously maintain in their head the attributes and characteristcs of that person. Dramatization serves as an hypothesis or prediction of how that person would react in a certain situation. This also contributes to the reduction of ego-centered perceptions.

11. JOURNAL KEEPING.

Writing and illustrating a personal log or a diary throughout an experience over a period of time causes the student to synthesize thoughts and actions and to translate them into symbolic form. The record also provides an opportunity to revisit initial perceptions, to compare the changes in those perceptions with the addition of more data, to chart the processes of strategic thinking and decision making, to identify the blind alleys and pathways taken, and to recall the successes and the "tragedies" of experimentation. (A variation on writing journals would be making video and/or audio tape recordings of actions and performances over time.)

12. MODELING.

Of all the instructional technqiues suggested, the one with the probablity of greatest influence on students is that of teacher modeling. Since students learn best by imitating the significant adults around them, the teacher who publicly demonstrates meta-cognition will probably produce students who meta-cogitate. Some indicators of teacher's public meta-

cognitive behavior might be: Sharing their planning--describing their goals and objectives and giving reasons for their actions; making human errors but then being seen to recover from those errors by getting "back on track"; admitting they do not know an answer but designing ways to produce an answer; seeking feedback and evaluation of their actions from others; having a clearly stated value system and making decisions consistent with that value system; being able to self-disclose--using adjectives that describe their own strengths and weaknesses; demonstrating understanding and empathy by listening to and accurately describing the ideas and feelings of others.

EVALUATING GROWTH IN META-COGNITIVE ABILITIES

We can determine if students are becoming more aware of their own thinking as they are able to describe what goes on in their head when they are thinking. When asked, they can list the steps and tell where they are in the sequence of a problem solving strategy. They can trace the pathways and dead-ends they took on the road to a problem solution. They can describe what data are lacking and their plans for producing those data.

We should see students becoming more perserverant when the solution to a problem is not immediately apparent. This means that they have systematic methods of analyzing a problem, knowing ways to begin, knowing what steps must be performed and when they are accurate or are in error. We should see students taking more pride in their efforts; becoming self-correcting, striving for craftsmanship and accuracy in their products, and becoming more autonomous in their problem solving abilities.

Teaching for thinking is becoming the great educational emphasis for the 80's. Meta-cognition is an attribute of the "educated intellect". It must be included if thinking is to become a durable reality for the 90's and beyond.

REFERENCES

Aspen Systems. TOPICS IN LEARNING AND LEARNING DISABILITIES. Gaithersburg MD. Aspen Systems Corp. Vol 2. No. 1. April, 1982 (Entire Issue)

Bloom, B. S. and Broder, L. J. PROBLEM-SOLVING PROCESSES OF COLLEGE STUDENTS. Chicago: University of Chicago Press. 1950

Brown, A. L. Knowing when, where, and how to remember: A problem of metacognition. in Glaser, (Ed.) ADVANCES IN INSTRUCTIONAL PSYCHOLOGY. Hillsdale, N. J: Erlbaum, 1978.

Chiabetta, E. L. A Review of Piagetian studies relevant to science instruction at the secondary and college level. SCIENCE EDUCATION. 1976. 60. 253-261.

Costa, A. L. Teaching for intelligent behavior. EDUCATIONAL LEADERSHIP Vol 39, No. 1 Oct. 1981.

Rigney, J. W. Cognitive learning strategies and qualities in information processing. In Snow, R., Federico, P., and Montague, W. (Eds.) APTITUDES, LEARNING, AND INSTRUCTION Vol 1. Hillsdale N. J. Erlbaum, 1980.

Sanacore, J. Metacognition and the improvement of reading: Some important links. JOURNAL OF READING. May, 1984 pp 706-712

Sternberg, R. and Wagner, R. Understanding intelligence: What's in it for Education: Paper submitted to the National Commission on Excellence in Education, 1982.

Whimbey, A. Students can learn to be better problem solvers. EDUCATIONAL LEADERSHIP. Vol 37. No. 7, April, 1980.

Whimbey, A. and Whimbey, L. S. INTELLIGENCE CAN BE TAUGHT. New York: Bantam Books, 1976

reprinted with author's permission

HOW THOUGHTFUL ARE YOUR CLASSROOMS?

Fourteen conditions for thinking have been identified in this article. Using these as criteria, rate your school in its effectivenessd in developing thinking skills.

		High Degree				Low Degree
1.	Does your community and staff value thinking as a primary goal of education?	5	4	3	2	1
2.	Does the staff believe that human intelligence can continue to grow throughout life with appropriate intervention?	5	4	3	2	1
3.	Have you reach consensus on or adopted some model of intellectual functioning?	5	4	3	2	1
4.	Are students aware that intelligent behavior is an objective of the instruction.	5	4	3	2	1
5.	Does the teachers' language (Questioning and structuring) invite students to think?	5	4	3	2	1
6.	Do the teachers' response behaviors extend and maintain higher levels of thinking?	5	4	3	2	1
7.	Are learning activities arranged in order of increasing complexity and increasing abstractionz?	5	4	3	2	1
8.	Do the materials of instruction support higher cognitive functioning?	5	4	3	2	1
9.	Is adequate instructional time devoted to thinking?	5	4	3	2	1
10.	Does instruction provide for differences in modality strengths?	5	4	3	2	1
11.	Are concepts and problem-solving strategies encountered repeatedly throughout, across and outside the curriculum?	5	4	3	2	1
12.	Do students and teachers dismiss thinking? (Meta Cognition)	5	4	3	2	1
13.	Do evaluation measures assess intelligent behaviors?	5	4	3	2	1
14.	Do significant adults model intelligent behaviors?	5	4	3	2	1

REFERENCE MATERIALS

There is a rich research base of materials for thinking skills programs. Psychology, education, neurological and brain research are only a few of the disciplines producing information and data pertinent to the improvement of thinking, reasoning, and the cognitive processes.

Anderson, John R.
Cognitive Skills and Their Acquisition. Hillsdale, NJ: Lawrence Earlbaum Associates, 1981.

Arlin, Patricia K.
Cognitive Development in Adulthood: A Fifth Stage. Developmental Psychology, 1975, 11 (5), 602-606.

Arlin, Patricia K.
Piagetian Operations in Problem Finding. Developmental Pyschology, 1977, 13 (3), 297-298.

Armbruster, Bonnie B. & Anderson, Thomas H.
Research Synthesis on Study Skills. Educational Leadership, November 1981, 39 (2), 154-156.

Barell, John
Reflections on Critical Thinking in Secondary Schools. Educational Leadership, March 1983, 40 (6), 45-49.

Beyer, Barry K.
Common Sense About Teaching Thinking Skills. Educational Leadership, November 1983, 41 (3), 44-49.

Beyer, Barry K.
Improving Thinking Skills -- Defining the Problem. Phi Delta Kappan, March 1984, 65 (7), 486-490.

Beyer, Barry K.
Improving Thinking Skills -- Practical Approaches. Phi Delta Kappan, April 1984, 65 (8), 556-560.

Boiarsky, Carolyn & Johnson, Clifford
The Excellence in Education Report: Connecting Reading, Writing, and Thinking. Curriculum Review, December 1983, 22 (5), 37-40.

Bloom, Benjamin S.
Human Characteristics and School Learning. New York: McGraw-Hill Book Co., 1976.

Brooks, Martin; Fusco, Esther; & Grennon, Jacqueline.
Cognitive Levels Matching. Educational Leadership, May 1983, 40 (8), 4-8.

Brown, Jerry L.
On Teaching Thinking Skills in the Elementary and Middle School. Phi Delta Kappan, June 1983, 64 (10), 709-714.

Bruner, Jerome S.
The Growth of Mind. (Occasional Paper No. 8) Cambridge, MA: Educational Services, Inc., 1966.

Bruner, Jerome S.
The Process of Education. New York: Vintage Books, 1960.

Bruner, Jerome; Goodnow, Jacqueline J.; & Austin, George A.
A Study of Thinking. New York: Science Editions, Inc., 1967.

Cohen, Josef
Thinking. Chicago: Rand McNally & Co., 1971.

Costa, Arthur L.
Teaching for Intelligent Behavior. Educational Leadership, October 1981 39 (1), 29-32.

de Bono, Edward
New Think. New York: Basic Books, 1967.

de Bono, Edward
The Direct Teaching of Thinking as a Skill. Phi Delta Kappan, June 1983, 64 (10), 703-708.

Feuerstein, Reuven
Instrumental Enrichment. Baltimore, MD: University Park Press, 1980.

Furth, Hans G. & Wachs, Harry
Thinking Goes to School. New York: Oxford University Press, 1974.

Gruber, Howard E.
Courage and Cognitive Growth in Children and Scientists. In Milton Schwebel & Jane Raph (Eds.), Piaget in the Classroom. New York: Basic Books, 1973, 73-80.

Gardner, Howard
Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Books, 1983.

Hartman - Haas, Hope J.
Thinking: A Forgotten Basic Skill. Paper presented at the New Jersey School Boards Association Conference. Atlantic City, NJ: NJSBA, November 1981, 16pp. (Photo-copy).

Hatcher, Margaret
Whole Brain Learning. The School Administrator, June 1983, 40 (5), 8-11.

Healy, Jane M.
Giving Our Children Time to Grow: Getting the Brain Behind the Curriculum. Independent School, December 1982, 42 (2), 25-29.

Henle, Mary
Cognitive Skills. In Jerome S. Bruner (Ed.) Learning About Learning: A Conference Report. Washington, DC: U.S. Department of Health, Education and Welfare, 1966, 53-63.

Hobbs, Nicholas
Feuerstein's Instrumental Enrichment: Teaching Intelligence to Adolescents. Educational Leadership, April 1980, 37 (7), 566-568.

Hughes, Carolyn Sue
Staff Development for Building Student Thinking Skills. Educational Leadership. October 1981, 39 (1) 48-51.

Hunt, Morton
The Universe Within. New York: Simon & Schuster, 1982.

Imel, Les & Kang, Hildi
Critical Thinking in a K-5 Setting: First the Staff and then the Students. Thrust for Educational Leadership, May-June 1983, 12 (7), 23, 28-29.

Kitchener, Karen Strohm
Cognition, Metacognition, and Epistemic Cognition: A Three-Level Model of Cognitive Processing. Human Development, July-August 1983, 26 (4), 222-232.

Levin, Joel R. & Allen, Vernon L.
Cognitive Learning in Children. New York: Academic Press, 1976.

Levy, Jerre
Research Synthesis on Right and Left Hemispheres: We Think with Both Sides of the Brain. Educational Leadership, January 1983, 40 (4), 66-71.

Lochhead, Jack
Research Synthesis on Problem Solving. Educational Leadership, October 1981, 39 (1), 68-70.

Lochhead, Jack & Clement, John (Eds.)
Cognitive Process Instruction. Philadelphia, PA: Franklin Institute Press, 1979.

Malone, Thomas W.
What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games. Palo Alto, CA: Xerox Palo Alto Research Center, 1980.

Martin, David S.
Thinking Skills: A Critical New Role in Teacher Education. Human Intelligence, Spring 1983, 4 (1), 3.

Maxwell, William (Ed.)
Thinking: The Expanding Frontier. Philadelphia, PA: Franklin Institute Press, 1983.

Olson, David R.
What is Worth Knowing and What Can Be Taught? School Review, 1973, 82 (11), 27-43.

Olson, David R.
Culture, Technology, and Intellect. In Lauren B. Resnick, (Ed.), The Nature of Intelligence. Hillsdale, NJ: Lawrence Erlbaum Associates, 1976, 189-202.

Penfield, Wilder
The Mystery of the Mind. Princeton, NJ: Princeton University Press, 1975.

Perkins, David N.
The Mind's Best Work: A New Psychology of Creative Thinking. Cambridge, MA: Harvard University Press, 1983.

Piaget, Jean
Piaget's Theory. In Paul H. Mussen (Ed.), Carmichael's Manual of Child Psychology, volume 1. New York: John Wiley and Sons, Inc., 1970, 703-732.

Piaget, Jean
Intellectual Evolution from Adolescence to Adulthood. Human Development, 1972, 15, 1-12.

Raths, Louis E.; Wasserman, Selma; Jonas, Arthur; & Rothstein, Arnold M.
Teaching for Thinking: Theory and Application. Columbus, OH: Charles E. Merrill, 1967.

Resnick, Lauren B. (Ed.)
The Nature of Intelligence. Hillsdale, NJ: Lawrence Erlbaum Associates, 1976.

Restak, Richard M., M.D.
The Brain: The Last Frontier. New York: Doubleday & Co., 1979.

Samson, Richard W.
Thinking Skills. Stamford, CN: Innovative Sciences, 1975.

Sheingold, Karen (Ed.)
Chameleon in the Classroom: Developing Roles for Computers. New York: Bank Street College of Education, Center for Children and Technology. Report No. 22, 1983.

Sinatra, Richard
Brain Research Sheds Light on Language Learning. Educational Leadership, May 1983, 40 (8), 9-12.

Snow, Richard E.
Intelligence, Motivation, and Academic Work. San Diego, CA: Paper presented to the National Commission for Excellence in Education, July 30, 1982, 13 pp., (Photo-copy).

Sternberg, Robert J.
The Nature of Mental Abilities. American Psychologist, March 1979, 34 (3), 214-230.

Sternberg, Robert J.
Intelligence as Thinking and Learning Skills. Educational Leadership, October 1981, 39 (1), 18-20.

Sternberg, Robert J.
Criteria for Intellectual Skills Training. Educational Researcher, February 1983, 12 (2) 6-12, 26.

Sternberg, Robert J.
What Should Intelligence Tests Test? Implication of a Triarchic Theory of Intelligence for Intelligence Testing. Educational Researcher, January 13 (1), 1984, 5-15.

Sylvester, Robert
A Child's Brain (in three parts), Instructor, Sept. - Dec. 1982.

Sylvester, Robert; Chall, Jeanne S.; Wittrock, M.C.; & Hart, Leslie A.
Educational Implications of Recent Brain Research. Educational Leadership, October 1981, 39 (1), 6-17.

Taba, Hilda
Implementing Thinking as an Objective in Social Studies. In Jean Fair & Fannie R. Shaftel (Eds.) Effective Thinking in the Social Studies, 37th Yearbook of NCSS, Washington, DC: National Council for the Social Studies, 1967, 25-49.

Vye, Nancy J. & Bransford, John D.
Programs for Teaching Thinking. Educational Leadership, October 1981, 39 (1), 26-28.

Walberg, Franette
Puzzle Thinking. Philadelphia, PA: Franklin Institute Press, 1980.

Whimbey, Arthur & Whimbey, Linda Shaw.
Intelligence Can Be Taught. New York: E.P. Dutton & Co., Inc., 1975.

Whimbey, Arthur & Lochhead, Jack
Problem Solving and Comprehension (3rd edition). Philadelphia, PA: Franklin Institute Press, 1982.

Wittrock, M.C. (Ed.)
The Brain and Psychology. New York: Academic Press, 1980.

Compiled by:

Dr. Barbara Presseisen
RESEARCH FOR BETTER SCHOOLS, INC.
Philadelphia, PA

CRITICAL THINKING RESOURCES

Educators working with students at different grade levels often have widely divergent objectives, but one goal that transcends all levels of pupil age and ability is the need to help students develop critical thinking skills.

The student who can analyze problems that require flexibility, orginality, and inventiveness can successfully arrive at both predetermined correct solutions and previously undiscovered solutions in the classroom and in the workplace.

The following bibliography lists materials on Critical Thinking that are currently available from the State Media Services Center. They may be obtained by sending a written request to:

Maryland State Department of Education
State Media Services Center
200 W. Baltimore Street
Baltimore, Maryland 21201
Attention: Information Services

Alvino, James
"How to Nurture Children's Creativity and Critical Thinking Skills"
PTA TODAY , v.9 (2), pp. 13-16, Nov. 1983.

The right kind of environment at home and in school can often turn an "average" student into a "gifted" one. Parents and teachers can help encourage the development of critical thinking skills. Special strategies are suggested.

****

Baird, Leonard L.
"Review of Problem Solving Skills"
Educational Testing Service, Princeton, NJ
March, 1983. ED 237 520 - Microfiche

This review considers the question as to whether there are generic problem-solving skills that cut across fields or whether the skills are so embedded within specific fields that they can be identified only within the contexts of those fields.

****

Beyer, Barry K.
"Improving Thinking Skills - Defining the Problem"
Phi Delta Kappan, v. 65 (7), pp. 486-90, March,1984

This article identifies five obstacles to effective teaching of thinking skills including: Lack of consensus among teachers, Lack of knowledge among teachers, Mistaking of skills testing for skills teaching, Teaching of too many skill in too little time, and testing that inhibits students' thinking skills.

Blank, Stanley S. and Thomas, David G.
"Enhancing Creative Thinking with Gifted Children in the Early Intermediate Grades"
B.C. Journal of Special Education, v.7 (2), pp.171-80, Summer, 1983.

In an examination of a school-based program to develop creative thinking skills of gifted children in the beginning intermediate grades, few differences were found in curricular achievement between gifted children in segregated homogeneous classes and in hetergeneous classes.

****

Brown, Jerry L.
"On Teaching Thinking Skills in the Elementary and Middle School"
Phi Delta Kappan, v. 64 (10), pp.704-14, June, 1983.

Sixty 15-minute television programs help students learn to reason and systematically solve problems. The goals are confident, flexible thinking; self-management; effective expression; and systematic reasoning. The cognitive skills emphasized include information collecting, classifying, and communicating effectively. A resource list is provided.

****

Cortes, Carlos E. and Richardson, Elinor.
"Why in the World: Using Television to Develop Critical Thinking Skills"
Phi Delta Kappan, v. 64, (10), pp. 715-16, June, 1983

A Public Broadcasting Service Television Series uses national and international current events to stimulate critical analysis in high school students.

****

De Bono, Edward
"The Direct Teaching of Thinking as a Skill"
Phi Delta Kappan, v 64 (10), pp. 703-08, June, 1983

This study emphasizes the relationship of perception to thinking and explains direct teaching of thinking. Without clarity of seeing and creativity, perception is shown to become narrow patterning. The Cognitive Research Trust program is recommended for teaching thinking skills using transferable thinking "tools". Self-images of students are enhanced by this program. (PB)

****

Edwards, Lois
"Teaching Higher Level Thinking Skills Through Computer Courseware"
March, 1983. ED 231 097 - Microfiche

A rationale is presented for helping gifted students gain computer literacy, learn programing, use utility software (e.g., word processing packages), and use interactive educational courseware containing drills, simulations, and games to develop higher level and creative thinking skills. Evaluation of courseware for gifted students is addressed briefly.

Elbon, Peter
"Teaching Thinking by Teaching Writing"
Change, v. 15 (6), pp. 37-40, Sept., 1983

Both first-order creative, intuitive thinking and second-order critical thinking can and should be encouraged in writing instruction. The first helps generate ideas, and the second is useful in refining expression. The two kinds of thinking enhance different writing skills and can be mutually reinforcing.

****

Gallini, Joan K.
"What Computer-Assisted Instruction Can Offer Toward the Encouragement of Creative Thinking"
Educational Technology, v.23 (4), pp. 7-11, April, 1983

This article argues that computer assisted instruction contributes to a creative environment for students with varying abilities by encouraging student self-selection, exploration of new ideas and divergent thinking skills, and interaction between tutor and learner. An example of computer use to spur creativity is included. Fourteen referneces are listed.

****

Henson, J.M
"Thinking Skills in the Classroom: A Needed Basic in Education"
Clearing House, v.56 (2), pp.6063, Oct., 1983

This article proposes a new emphasis on and suggests a methodology for teaching critical thinking.

****

Houtz, John C. and Denmark, Robert
"Student Perceptions of Cognitive Classroom Structure and Development of Creative Thinking and Problem Solving Skills"
Educational Research Quarterly, v. 8 (3), pp. 20-26, 1983

Among the research results on the perceptions of 207 intermediate grade students was the indication that, while problem-solving performance related only to intelligence and math achievement scores, ideational fluency related significantly to student perceptions of emphasis on higher level thinking skills in the classroom and positive classroom climate.

****

"How to Turn Your Class Into a Think Tank"
Instructor, v. 92 (6), pp. 116-118, Feb., 1983

Eleven specific thinking skills are discussed, along with activities to help teachers develop each skill in their students. The skills are: (1) observing; (2) comparing; (3) classifying; (4) imagining; (5) hypothesizing; (6) looking for assumptions; (7) collecting and organizing data; (8) summarizing; (9) interpreting; (10) problem solving; and (11) decision making.

Lehr, Fran
"Developing Critical and Creative Reading and Thinking Skills"
Language Arts, v. 60, (8), pp. 1031-35, Nov.-Dec., 1983

Examines materials in the ERIC system offering teaching ideas and activites designed to promote critical and creative thinking and reading. Discusses the role of teacher questioning techniques and writing to structure thoughts.

****

McLendon, Gloria H.
"Exploring the Research Concerning Left Hemisphere/Right Hemisphere Cognitive Processes and Examining One Instructional Technique Which May Be Implemented Across the Curriculum to Produce Holistic Thinkers"
1982, 35 pages ED 223 541 - Microfiche

This article reviews current writings on the hemispheres of the brain, and discusses possible implications for improving present educational techniques.

****

Valett, Robert E.
"Strategies for Developing Creative Imagination and Thinking Skills"
1983, 182 pages, 233 533 - Microfiche

A practical guidebook of ideas, lesson plans, and related resources for developing imaginative and productive thinking skills is presented. Emphasis is placed on playfulness, originality, mental imagery, and reflection.

****

Von Kuster, Lee N.
"Strategies, Not Solutions Involving Students in Problems Solving"
Curriculum Review, v 23, (1), pp. 61-63, Feb., 1984

This article defines problem solving, dicusses the use of problems developed by students that are relevant to their own lives, presents examples of practical mathematics problems that deal with local situations, discusses fringe benefits of this type of problem solving, and addresses teachers' concern that this method consumes too much time.

++=======++=======++=======++=======++=======++=======++=======++=======++=======++=======++

The following list contains titles of Computer Programs that have been ordered by the State Media Service Center. They will be available in mid-October.

Advertising Techniques
32 K. Apple II., disk drive, monitor
Applesoft, DOS 3.2 or 3.3 5 1/4" disk
Manufacturer: Micro Power and Light Co.
12820 Hillcrest Road
STE. 224
Dallas, Texas 75230
(214) 239-6620

This program presents four advertising techniques and examples that help students develop critical analysis skills. Grades 7-12

<><><><>

Facts or Opinion
48 K Apple II, IIe, or II plus with disk drive
5 1/4" disk
Manufacturer: Learning Well
200 South Service Road
Roslyn Heights, NY 11577

In this program the player is placed in a shopping mall and asked to discern between factual advertising and puffery. Fact or Opinion combines reading comprehension with an introduction to critical thinking. Geared to grades 3-5.

<><><><>

Subtraction
Atari 400, Atari 800
32 K, disk drive or 16 K, cassette recorder
1983
Manufacturer: The Wizard
18584 Carlwyn Drive
Castro Valley, CA 94546

This computer software package includes "Stars", a game in which subtraction and critical thinking are necessary to win. Six levels of difficulty for grades 1-6.

//////++//////++//////++//////++//////++//////++//////

The following list of five books contains titles that have been ordered by the State Media Services Center. They will be available in mid-October.

Brooks, Bearl
Basic Skills Learning To Think Workbook
Basic Skills Workbooks, 1983.

Provides a systematic approach to assisting elementary students acquire critical thinking skills.

Fernside, W. Ward
About Thinking
Prentice-Hall, 1980

Discuss the thinking process, and its implications for the educator.

{}{}{}{}

Freeman, Darlene
A New Way To Use Your Bean: Developing Thinking Skills in Children
Trillum Press, 1981

Suggests strategies for parents and teachers interested in fostering critical thinking skills.

{}{}{}{}

Ruggiero, Vincent R.
The Art of Thinking
Harper & Row, 1983

Ruggiero's book explores thought processes and examines ways in which they can be consciously amplified.

{}{}{}{}

Tonjes, Marian J. and Zintz, Miles
Teaching Reading, Thinking, Study Skills in Content Classrooms
Wm. C. Brown, 1981

Discusses how critical thinking can be applied across the curriculum.

QUESTIONS TO CONSIDER WHEN EXAMINING THINKING SKILLS PROGRAMS

A number of programs have been developed for the purpose of improving student thinking skills. These programs vary in terms of their theoretical underpinnings, the thinking skills upon which they focus, the teaching methods they utilize, and their implementation requirements. The following questions may be useful to consider when examining such programs:

1. Is the program based on a theoretical model?

2. What thinking skills are identified, developed and evaluated by the program?

3. Are the identified thinking skills explicitly taught or are they imbedded within the curriculum?

4. What is the target population of the program (e.g. grade level, subject area, ability level)?

5. What is the teacher's role in implementing the program? What instructional methods are employed?

6. What instructional materials are required? What supplementary materials are available?

7. What are the teacher training requirements for the program?

8. What are the implementation and maintenance costs for the program? What are the per pupil costs?

9. What is the evaluation evidence of effectiveness of the program?

10. Is the program being conducted at a nearby school? If so, what is the name of a contact person who could answer questions and/or arrange for an observation visit?

Other questions:

Jay McTighe
Maryland State Department of Education

BEST COPY AVAILABLE

INSTRUMENTS FOR ASSESSING THINKING

A number of instruments are currently available for use in the assessment of thinking. The following list presents the titles, grade level focus and publisher's address for several of the most widely used tests. More detailed information may be obtained from the publishers.

BASIC SKILLS FOR CRITICAL THINKING (1979)

by: Gary E. McCuen
grades: 9 - 12
publisher: Greenhaven Press, Inc.
577 Shoreview Park Road
St. Paul, MN 55112

CORNELL CRITICAL THINKING TEST, LEVEL X (1982)

by: Robert H. Ennis and Jason Millman
grades: 4 - 14
publisher: Illinois Thinking Project
Education Building
University of Illinois
Champaign, IL 61820

DEVELOPING COGNITIVE ABILITIES TEST (1980)

by: Scott, Foresman and Company Test Division
grades: 2 - 12
publisher: American Testronics
P.O. Box 2270
Iowa City, Iowa 52244

THE ENNIS-WEIR CRITICAL THINKING ESSAY TEST (1983)

by: Robert H. Ennis and Eric Weir
grades: 7 - college
publisher: Illinois Thinking Project
Education Building
University of Illinois
Champaign, IL 61820

NEW JERSEY TEST OF REASONING SKILLS (1983)

by: Virginia Shipman
grades: 4 - college
publisher: IAPC, Test Division
Montclair State College
Upper Montclair, NJ 07043

ROSS TEST OF HIGHER COGNITIVE PROCESSES (1976)

by: John D. Ross and Catherine M. Ross
grades: 4 - college
publisher: Academic Therapy Publications
20 Commercial Boulevard
Novato, CA 94947

SEA TEST (1982)

grades: 5 - 8
publisher: The Bureau of Educational Research
264 Ruffner Hall
University of Virginia
Charlottesville, VA 22903

WATSON-GLASER CRITICAL THINKING APPRAISAL (1980)

by: Goodwin Watson and Edward Maynard Glaser
grades: 9 - college
publisher: The Psychological Corporation
A subsidiary of Harcourt Brace Jovanovich
7500 Old Oak Boulevard
Cleveland, OH 44130

Jay McTighe
Maryland State Department of Education

PUBLISHED PROGRAMS AND MATERIALS

A number of publishers offer materials for teaching thinking (K-12) as a separate teaching area or as aids for classroom integrations in other subjects. Individual publishers can be contacted for discriptive brochures and ordering procedures.

Program

Basic Thinking Skills Program
Midwest Publications
P.O. Box 448
Pacific Grove, CA 93950

CoRT Thinking Programs
Pergamon Press Inc.
Fairview Park, Elmsford, NY 10523

D.O.K. Publishers, Inc.
71 Radcliffe Road
Buffalo, NY 14214

Instrumental Enrichment
Reuven Feuerstein, author.
Curriculum Development Associates
1211 Connecticut Avenue, N.W.
Suite 414
Washington, D.C. 20036
(202) 293-1760

Just Think Programs (de Bono)
Thomas Geale Publications, Inc.
1142 Manhattan Ave.
Drawer C.P. 223
Manhattan Beach, CA 90266
(213) 379-4405

Mindstretchers
Pitman Learning, Inc.
6 Davis Drive
Belmont, CA 94002

Philosophy for Children
Institute for the Advancement
of Philosophy for Children
Montclair State College
Upper Montclair, NJ 07043

Problem-Solving Newsletter
Franklin Institute Press
20th & Race Streets
Box 2266
Philadelphia, PA 19103

Productive Thinking Program (Gr. 5-10)
Charles E. Merrill Publishing Co.
1300 Alum Creek Drive
P.O. Box 208
Columbus, OH 43216

S O I Institute
343 Richmond Street
El Segundo, CA 90245

Strategic Reasoning
Innovative Sciences, Inc.
Park Square Station
P.O. Box 15129
Stamford, CT 06901

ThinkAbout
Agency for Instruction Television
Box A
Bloomington, IN 47402

Thinking Skills Development Program
Benefic Press
10300 W. Roosevelt Road
Westchester, IL 60153

compiled by:

Dr. Barbara Presseisen
RESEARCH FOR BETTER SCHOOLS
Philadelphia, PA

Thinking: How Do We Know

Students Are Getting Better At It?

by Arthur L. Costa
Professor of Education, California State University, Sacramento

Almost all human beings move. With training, movement can be performed with precision, style, and grace. For a gymnast or ballerina, this takes years of rehearsal, concentration, and coaching. Improvement is assessed by the demonstration of increasing mastery of complex and intricate maneuvers performed repeatedly on command with sustained and seemingly effortless agility. Distinction between awkwardness and nimbleness is obvious to even the most undisciplined observer.

Almost all humans think. Some do more than others. Like strenuous movement, thinking, too, is hard work. With training, human thought processes can become more broadly applied, more precisely focused, more spontaneously generated, more intricately complex, more metaphorically abstract, and more insightfully divergent. Such refinement also requires rehearsal, concentration, and coaching. Unlike athletic performance, however, thinking is most often covert--inside the head. Assessment of its increased mastery and stamina is therefore illusive. Awkwardness and nimbleness in thinking, however, may be distinguished by the keen observer.

When considering how evidence of students' achievement is collected, we most often think of testing--using some form of paper and pencil instrument to determine how many questions a student answers correctly. While there may be some types of thinking that can be assessed in this fashion--lower level comprehension, for example--we must seek other means of determining growth in intellectual abilities. In teaching students to think, the emphasis is not on how many answers they know. Rather, the focus is on how they behave when they don't know. We are interested in observing how students produce knowledge rather than how they merely reproduce knowledge. A critical characteristic of intellectual ability is not only having information, but knowing how to act upon it.

By definition, a problem is any stimulus, question, or phenomenon, the explanation for which is not immediately known. Thus, student performance is assessed under challenging conditions which demand strategies, insightfulness, perseverance, and craftsmanship to resolve the problem.

Many teachers are unimpressed with standardized tests (Harootunian and Yarger, 1980; Lazer-Morrison, et al, 1980). The results are often unavailable for several weeks or months after administering the test; thinking skills are contaminated by the degree to which students are acquainted with the subject matter; behavior is influenced by the mental and emotional state of the students at the time of testing; performance is subject to the vicissitudes of the situation; scores yield neither diagnostic clues as to how the student derived the answer (metacognition) nor how the student processed the data and emotions necessary to arrive at the best answer (cognitive mapping) (Anderson, 1981; Coffman, 1980).

Teachers know that many students are deemed gifted because they are test

wise. They also know that other students are often overlooked because they do poorly under testing conditions. While competency may be demonstrated in a single test, effectiveness is demonstrated by sustained performance in a variety of situations which demand the selective and spontaneous use of clusters and linkages of problem-solving strategies rather than singular, isolated behaviors.

As students interact with real life, day-to-day classroom problems, what might teachers search for as indicators that their instructional efforts are paying off? Following are ten suggested characteristics of intellectual growth which teachers can observe and record (Feuerstein, 1980). Keeping anecdotal records of a student's acquisition of these types of behaviors provides more useable information about growth in intellectual behaviors than typical norm-referenced, multiple choice, standardized achievement tests.

1. Persevering when the solution to a problem is not immediately apparent. Students often give up in despair when the answer to a problem is not immediately known. We can observe them crumple their papers and throw them away saying, "I can't, or "It's too hard." They lack the ability to analyze a problem, to develop a system, structure, or strategy of problem attack.

   Thinking students grow in their ability to use alternative strategies of problem-solving. If one strategy doesn't work, they know how to back up and try another. They realize that the theory or idea must be rejected and another employed. They have systematic methods of analyzing a problem, knowing ways to begin, knowing what steps must be performed, what data need to be generated or collected. This is what is meant by perseverance.

2. Decreasing impulsivity. Often students blurt the first answer that comes to mind. Sometimes they shout out an answer, start to work without fully understanding the directions, lack a plan or strategy for approaching a problem, or make immediate value judgements about an idea before fully understanding it.

   As students become less impulsive, we can observe them decreasing the number of erasures on their papers, gathering much information before they begin a task, taking time to reflect on an answer before giving it, making sure they understand directions before beginning a task, listening to alternative points of view, and planning a strategy for solving a problem.

3. Flexibility in thinking. Some students have difficulty in considering alternative points of view or dealing with more than one classification system simultaneously. Their way to solve a problem seems to be the only way. They are more interested in knowing whether their answer is correct or not, rather than being challenged by the process of finding the answer. They are unable to sustain a process of problem-solving over time and therefore avoid ambiguous situations. They have a need for certainty rather than an inclination for doubt.

   As students become more flexible in their thinking they can be heard considering, expressing, or paraphrasing another person's point of

view or rationale. They can state several ways of solving the same problem and can evaluate the merits and consequences of two or more alternate courses of action. When making decisions they will often use such words as "however," "on the other hand," "if you look at it another way...." or "John's idea is...., but Mary's idea is...."

4. Meta-cognition: the ability to know what we don't know. Some people are unaware of their own thinking processes. They are unable to describe the steps or strategies they use during the act of problem-solving. They cannot transform into words the visual images held in their minds. They seldom evalute the quality of their own thinking skills.

   We can determine if students are becoming more aware of their own thinking as they are able to describe what goes on in their head when they think. When asked, they can list the steps and tell where they are in the sequence of a problem-solving strategy. They can trace the pathways and blind alleys they took on the road to a problem solution. They can describe what data are lacking and their plans for producing those data (Sternberg and Wagner, 1982).

5. Checking for accuracy. Students are often careless when turning in their completed work. When asked if they have checked over their papers, they might say, "No, I'm done." They seem to feel little inclination to reflect upon the accuracy of their work, to contemplate their precision, or to take pride in their accomplishments. Speed of getting the assignment over with surpasses their desire for craftsmanship.

   We can observe students growing in their desire for accuracy as they take time to check over their tests and papers, as they grow more conscientious about precision, clarity, and perfection. They go back over the rules by which they were to abide, the models they were to follow, and the criteria they were to employ to confirm that their finished product matches exactly.

6. Problem-posing. One of the distinguishing characteristics between humans and other forms of life is our ability to find problems. Yet, students depend on others to solve problems, to find answers, and to ask questions for them (Brown, 1983).

   Over time, we want to see a shift from teachers asking questions and posing problems, toward students asking questions and finding problems for themselves. Furthermore, the types of questions students ask should change and become more specific and profound. For example:

   We seek an increase in requests for data to support conclusions and assumptions. Such questions as, "What evidence do you have....?" or "How do you know that's true?" will be heard.

   We want to hear more hypothetical problems. These are characterized by "iffy" type questions: "What do you think would happen if...," or "If that is true, then..."

   We want students

to recognize discrepancies and phenomen in their environment and to inquire into their causes: "Why do cats purr?" "How high can birds fly?" "Why does the hair on my head grow so fast, but the hair on my arms and legs doesn't?" "What would happen if we put the salt water fish in the fresh water aquarium?" "What are some alternative solutions to international conflicts other than wars?"

7. Drawing on past knowledge and experiences. Too often students begin each new task as if it were being approached for the very first time. Teachers are often dismayed when they invite students to recall how they solved a similar problem previously and students don't remember. It's as if they never heard of it before, even though they had the same type of problem just recently. It is as if each experience is encapsulated and has no relationship to what has come before or what comes afterward.

   Thinking students are able to abstract meaning from one experience and carry it forth to apply it in the next experience. Students can be observed growing in this ability as they are heard saying, "This reminds me of...." or "This is just like the time when we...." They explain what they are doing now in terms of analogies with or references to previous experiences. They call upon their store of knowledge and experience as sources of data to support, theories to explain, or processes to solve each new challenge.

8. Transference beyond the learning situation. Probably the ultimate goal of teaching thinking skills is for the students to apply school-learned knowledge to real life situations and to content areas beyond that in which it was taught. Yet, we find that while students can pass mastery tests in mathematics, for example, they often have difficulty in deciding whether to buy six items for $2.38 or seven for $2.86 at the supermarket.

   When parents and other teachers report how they have observed students thinking at home or in other classes, we know students are transferring. Parents, for example, may report increased interest in school, more planning in their child's use of time and finances, in increased organization of their room, their books, and their desks at home.

   We might hear, for example, the social studies teacher describe how a student used a problem-solving strategy which was originally learned in the science class. We might hear the wood shop teacher tell how a student volunteered a plan to measure accurately before cutting a piece of wood: "measure twice and cut once," an axiom learned in the math class.

9. Precision of language. Some student's language is confused, vague, or imprecise. They describe attributes of objects or events with such non-specific words as "weird," "nice," or "O.K." Names for objects are such as "stuff," "junk," or "things." Their sentences are often punctuated with "ya know," "er," and "uh."

   As students' language becomes more precise, they can be heard using more descriptive words to distinguish attributes. They will use more correct names, and when universal labels are unavailable, they will use analogies such as "crescent shaped" or "like a bowtie." They

will speak in complete sentences, voluntarily provide supportive evidence for their ideas, elaborate, clarify, and operationally define their terminology. Their speech will become more concise, descriptive, and coherent.

10. Enjoyment of problem-solving. Some children and adults avoid problems. We often hear them saying something like, "These types of thinking games turn me off," "I was never good at these brain teasers," or "Go ask your father; he's the brain in this family." Many people never enrolled in another math class or other "hard" academic subject after they didn't have to in high school or college. Many people perceive thinking as hard work and therefore recoil from situations which demand "too much" of it.

    We want to observe students moving not only from an "I can" attitude but also towards an "I enjoy" feeling. We will notice students seeking out problems to solve for themselves and to submit to others. They will make up problems to solve on their own and request them from others. Furthermore, students will solve problems with increasing independence, without the teacher's help or intervention. Such statements as "Don't tell me the answer, I can figure it out by myself," will indicate growing autonomy.

In summary. This list of indicators of increasing use of thinking skills is not meant to be complete. Each teacher will want to add to it more indicators of growing intelligence which they value. The intent is to stress that most teachers neither need nor use standardized tests to determine the effectiveness of their teaching for thinking. Such tests assess what is measureable but insignificant. Significant problem-solving behaviors are displayed and can be observed daily if we know how to look. How much we've evaluated how well we've taught what's not worth learning!

As teachers, we have great responsibility for instilling intelligent behaviors such as these in our students. We must teach them to value intelligent and rational action. To do so, however, we must provide the conditions for the behaviors of intelligence to be practiced and demonstrated. We must believe that all students can continue to grow in their ability to behave more intelligently. We must have faith that all humans can become increasingly more gifted than they are presently capable of demonstrating. Finally, we must set an example by becoming models of these intelligent behaviors ourselves (Costa, 1983).

Bibliography

Anderson, S. Testing and coaching. Paper presented at the annual meeting of the American Association of School Administrators, Atlanta, GA, 1981.

Brown, I. The art of problem posing. Philadelphia: The Franklin Institute Press, 1983.

Coffman, W. E. Those achievement tests--how useful? Executive Review, Vol. 1, No. 1, 1980, pp. 2-5.

Costa, A. Teaching toward intelligent behavior, in Maxwell, W. (ed.), Thinking the expanding frontier. Philadelphia: The Franklin Institute Press, 1983, pp. 211-221. (This article further describes those teacher behaviors and classroom conditions which promote thinking.)

Feuerstein, R. Instrumental enrichment. Baltimore: University Park Press, 1980. Several of these behavioral indicators are derived from the curriculum Instrumental enrichment. (Teachers who have taught this program report having observed changes in student behaviors similar to those described herein.)

Harootunian, B. & Yarger, D. Teacher's conceptions of their own success. Washington, DC, February, 1981. (ERIC Clearinghouse on Teacher Education, Clearinghouse #SP 017 372.)

Lazar-Morrison, C. & others. A review of the literature on test use. Los Angeles: Center for the Study of Education, 1980.

Sternberg, R. & Wagner, R. Understanding intelligence: what's in it for educators? Paper submitted to the National Commission on Excellence in Education, (city unknown), July, 1982, pp. 48-52.

reprinted with author's permission

jw
10/28/83

SOME THOUGHTS ON THINKING AND ITS DEVELOPMENT

Compiled by: Jay McTighe
Maryland State Department of Education

"Solutions to the significant problems facing modern society demand a widespread, qualitative improvement in thinking and understanding. We are slowly and painfully becoming aware that such diverse contemporary challenges as energy, population, the environment, employment, health, psychological well-being of individuals and meaningful education of our youth are not being met by the mere accumulation of more data or the expenditure of more time, energy or money. In view of the increasing pressures imposed on our society by these problems, many responsible thinkers have realized that we cannot sit back and hope for some technological invention to cure our social ills. We need a breakthrough in the quality of thinking employed both by decision-makers at all levels of society and by each of us in our daily affairs."

Robert Ornstein

"We must return to basics, but the 'basics' of the 21st century are not only reading, writing and arithmetic. They include communication and higher problem-solving skills, and scientific and technological literacy- the thinking tools that allow us to understand the technological world around us."

Educating Americans for the 21st Century

"It must be remembered that the purpose of education is not to fill the minds of students with facts...it is to teach them to think, if that is possible, and always to think for themselves."

Robert Hutchins

"Knowledge is the most powerful problem-solving tool there is. If I want to solve problems in mathematics I've got to have mathematical concepts. But there's a difference between teaching knowledge as a tool that facilitates problem solving and teaching it simply as a thing to be memorized."

John Bransford

"We should be teaching students how to think; instead we are primarily teaching them what to think."

Jack Lochhead

"There are one-story intellects, two story intellects, and three-story intellects with skylights. All fact collectors who have no aim beyond their facts are one-story men. Two-story men compare, reason, generalize, using the labor of fact collectors as their own. Three-story men idealize, imagine, predict--their best illumination comes from above the skylight.

Oliver Wendell Homes

"The favorable circumstances (for problem-solving) is that the problem should be sensible and meaningful for the learner. By contrast, solutions learned by rote processes or by not understood formulas are likely to be less well remembered and less satisfactorily applied to new situations.

Ernest R. Hilgard

"The principal goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done--men who are creative, inventive, and discovers. The second goal of education is to form minds which can be critical, can verify, and not accept everything they are offered."

Jean Piaget

"Creativity involves breaking out of established patterns in order to look at things in a different way."

Edward DeBono

"An idea is a feat of association.

Robert Frost

"The mere formulation of a problem is often far more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science.

Albert Einstein

"Creativity is so delicate a flower that praise tends to make it bloom, while discouragement often nips it in the bud. Any of us will put out more and better ideas if our efforts are appreciated...to get creative behavior, we must reward it."

Paul Torrance

"There are two ways to slide easily through life; to believe everything or to doubt everything. Both ways save us from thinking."

Alfred Korzybski

"In the case of any person whose judgements is really deserving of confidence, how has it become so? Because he has kept his mind open to criticism of his opinions and conduct. Because it has been his practice to listen to all that could be said against him; to profit by as much of it as was just, and expound to himself, and upon occasion to others, the fallacy of what was fallacious. Because he has felt, that the only way in which a human being can make some approach to knowing the whole of a subject, is by hearing what can be said about it by persons of every variety of opinion, and studying all modes in which it can be looked at by every character of mind. No wise man ever acquired his wisdom in any mode but this; nor is it in the nature of human intellects to become wise in any other manner."

John Stuart Mill

"It is not best that we should all think alike; it is difference of opinion which makes horse races."

Mark Twain

"It is good to rub and polish our brain against that of others."

Montaigne

"Education is training in HOW to think rather than in WHAT to think; it is a confrontation, a dialogue between ways of assessing evidence and supporting conclusions. It implies that the teacher's primary job is that of making clear the bases upon which he weighs the facts, the methods by which he separates facts from fancies, and the ways in which he discovers and selects his ultimate norms...This concept of teaching...requires that the purported facts be accompanied by the reasons why they are considered the facts. Thereby the teacher exposed his methods of reasoning to test and change. If the facts are in dispute...then the reasons why others do not consider them to be facts must also be presented, thus bringing alternative ways of thinking and believing into dialogue with each other."

Emerson Shideler

"Questions are the creative acts of intelligence."

Frank Kingdon

"After several years of intensive work on these matters, the improvements in students' higher mental process learning and achievement became very pronounced. These and other approaches made it clear that most students could learn the higher mental processes if they became more central in the teaching-learning process."

Benjamin Bloom

"We teach a subject not to produce little 'living libraries' on that subject, but rather to get a student to take part in the process of knowledge--getting. Knowledge is a process not a product."

Jerome Bruner

"Give me a fish and I will eat today. Teach me to fish and I will eat for a lifetime."

Chinese Proverb

"The level of the development of a country is determined, in considerable part, by the level of development of its people's intelligence..."

Luis Alberto Machado

"Change your thoughts and you change your world."

Norman Vincent Peale

"Thinking in its higher forms is a kind of poetry."

Havelock Ellis

"Thought alone is eternal."

Owen Meredith